Draft for Discussion

Faro Mine Complex Closure Vegetation Baseline

Prepared for
Faro Project Management Team

Submitted by
Gartner Lee Limited

February, 2008

Gartner Lee

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Reference: **GLL 70384-1**

Distribution:

4 Faro Project Management Team

2 Gartner Lee Limited

Gartner Lee

Executive Summary

draft for discussion

A vegetation baseline assessment was conducted for the Faro Mine Complex Closure Project in 2007 to identify the current condition of vegetation components of the ecosystem at a local and regional scale. A vegetation Local Study Area (LSA) was developed to incorporate a 1 km buffer around the Project footprint, resulting in a study area of approximately 81.2 km^2. This LSA was designed to represent the diversity of vegetation in the immediate Project area and to encompass the area within which all-direct effects and some indirect effects of Project activities on vegetation are likely to occur. Baseline information for the assessment of health effects to vegetation at a regional scale was summarized from the study, "Anvil Range Mine Complex - Terrestrial Effects Study: Investigation into Metal Concentrations in Vegetation, Wildlife and Soils" (Gartner Lee Ltd. et al 2006).

The assessment of environmental effects for the Project was based on the primary issues for vegetation, which include:

- Health of vegetation on the landscape and the potential for transfer of contaminants to wildlife and humans through plant uptake and ingestion; and
- Sustainable cover of vegetation on the landscape, consistent with native vegetation communities in the region.

Field activities in 2007 focused on surveying representative vegetation associations in the LSA in order to describe their composition and develop vegetation map units. The characteristic composition and cover of species in each vegetation association was determined through standardized plot sampling in representative areas for a total inventory of 17 ground plots and 59 visual calls. Additional field data from a revegetation planning field program conducted by Environmental Dynamics Inc. (EDI) was used to develop vegetation association map units (information to be updated).

Thirteen vegetation associations were identified and mapped within the LSA. Vegetation associations in this mountainous area include forested and wetland associations in the low elevation valley bottoms and low-lying terrain of the boreal zone, below 1200 m. Closed forests of white spruce/willow cover the largest portion 45% of the LSA. There are small areas of pine, mixed coniferous-deciduous and deciduous forests. Also present are shrub associations of dwarf birch and willow. Poorly drained lowland sites support dwarf birch, willow, sedge and graminoid associations. The areas of the Project LSA above 1200 m are in the subalpine zone, which is dominated by tall shrub vegetation. Scattered open spruce and fir forests occur at the lower limits, grading into lower stature shrub, herb and lichen communities at upper elevations.

There are currently no records for rare or at risk plant species in the Project LSA. Surveys for rare vascular plant species will occur in any areas where new disturbance to previously undisturbed native plant communities is planned.

Native vegetation has historically been removed from a 1612.7 ha (16.1km2) area by the development of the Faro Mine Complex.

The results of the terrestrial effects study for the Faro Mine Complex show that the presence of the mine has resulted in elevated concentrations of several elements both at the mine site and in the surrounding area.. The area affected by some elements is large. For example, concentrations of lead are elevated in an area that is known to be at least and which is probably greater than 1,760 km2. Two distinct sources are associated with the mine and mining operations. The mine itself is the source of most elemental deposition; however, a breach of the tailings dam in 1975 resulted in the deposition of tailings along watercourses to the northwest of the mine site. These tailings deposits, which occur discontinuously, may provide a secondary source of water- and air-borne deposition, which could extend the area affected by elevated elemental concentrations. The presence of elevated elemental concentrations in plants consumed by humans and animals indicates that these elements are entering the environmental food chain and also have the potential to be incorporated into the human food chain.

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1. Introduction

The diversity, distribution and health of vegetation in natural ecosystems play an important role in ecosystem function. Vegetation patterns on the land are influenced by climate, substrate, terrain and water availability. Characteristic groupings of vegetation occur on the landscape, influenced by substrate, moisture and nutrient regimes. Different vegetation associations provide a variety of habitats used by wildlife. Wildlife and people can influence vegetation abundance and diversity and industrial development in particular has the potential to affect vegetation ecosystem health.

The objectives of the vegetation baseline assessment for the Closure and Remediation Plan for the Faro Mine Complex (the Project) are to identify the current condition of vegetation components of the ecosystem, including:

- Composition and cover of vegetation associations at a local scale; and
- Levels of contaminants from the Faro Mine Complex in vegetation in the region.

The environmental assessment of the effects of the Project will then:

- Identify effects of the Project on the baseline condition of vegetation components of the ecosystem;
- Identify mitigation;
- Evaluate the predicted residual effects and their significance; and
- Identify vegetation monitoring requirements.

1.1 Regional Setting – Vegetation

The Faro Mine Complex is located within the Yukon Plateau-North Ecoregion, in the Boreal Cordillera Ecozone of the Yukon (Environment Canada, 2005). The region consists of rolling uplands, small mountain groups, and nearly level tablelands dissected by U-shaped valleys. A prominent valley called the Tintina Trench traverses the ecoregion from southeast to northwest. The mine complex lies within the zone of discontinuous, widespread permafrost, wherein Turbic Cryosolic and Eutric Brunisolic soils predominate and occasional pockets of Dystric Brunisols occur on coarse-textured morainal and fluvioglacial materials. Vegetation is predominantly white spruce with willow, dwarf birch, ericaceous shrubs, and occasionally, lodgepole pine. Poorly drained lowland sites consist of black spruce, scrub willow, birch, and mosses. Subalpine areas are vegetated with alpine fir, lodgepole pine mountain avens, dwarf willow, birch, ericaceous shrubs, graminoid species, and mosses (Environment Canada, 2005).

2. Impact Assessment

2.1 Issue Focused Approach

Although a preferred option for closure has yet to be selected for the Project, an issue-based approach was used to focus the baseline information collection and Valued Ecosystem Component (VEC) selection for vegetation. The primary issues for vegetation are whether Project activities will result in changes to:

- Health of vegetation on the landscape and the potential for transfer of contaminants to wildlife and humans through plant uptake and ingestion; and
- Sustainable cover of vegetation on the landscape, consistent with native vegetation communities in the region.

* (This is a preliminary list and public consultation to confirm or expand this list is necessary.)

3. Valued Ecosystem Components

The VECs selected for the vegetation impact assessment related to the issue of health of vegetation on the landscape, is:

- Vegetation Health.
- Sustainable native vegetation cover
- Vegetation diversity

Maintaining vegetation health an important component of maintaining ecosystem health. Vegetation is a receptor for pollutants through uptake from soil, water, from air through gas exchange or through deposition on vegetation surfaces. Absorption by vegetation is one mechanism by which pollutants enter living components of an ecosystem and the food chain. Pollutants can accumulate in vegetation tissues. At higher concentrations pollutants can affect plant health and the composition and abundance of vegetation communities.

The VECs selected for the vegetation impact assessment related to the issue of diversity of vegetation on the landscape include:

- Rare and threatened plant species
  - Vascular plants ranked as S1 or S2 in the Yukon Status Ranks document;
  - Vascular plant species ranked as "at risk" or "may be at risk" in the document "Wild Species 2005: The General Status of Species in Canada" (CESCC 2006); and
  - Vascular plants and bryophytes listed under Schedule 1 (or pending Schedule 1) of the Species at Risk Act (SARA) (Government of Canada 2007).

These vegetation species or species associations are important to the diversity, health and/or function of the ecosystem. Indicators and thresholds for effects to these ecosystem components are identified in Table 1.3-1. Indicators are chosen to evaluate potential Project effects on the abundance, diversity and health of each of the VECs selected. Thresholds are measurable parameters of the indicator that demonstrate the level of unacceptable change.

Table 3-1. Vegetation VECs, Indicators and Thresholds

Issue	VEC	Indicator	Threshold
Vegetation health	**Vegetation health** – annual atmospheric concentrations or accumulations of pollutants resulting in changes in phenology and community composition	Accumulation of TSP Cumulative deposition of Zn and Pb	Annual deposition of TSP >4.6 g/m^2/yr Cumulative deposition of Zn >15 g/m^2 Cumulative deposition of Pb > x
Vegetation health	**Sustainable Native Vegetation Cover**	Persistent, weed free surface cover of native vegetation on disturbed, erosive surfaces.	X % cover on erosive substrates < x% cover of weeds or non-native species
Vegetation diversity	**Rare or Threatened plant species**	Presence of rare or threatened plant species	>20% loss of a population of rare (S1, S2) or "may be at risk" plant species

Notes: Total Suspended Particulates (TSP), zinc (Zn) and lead (Pb).

4. Study Areas

4.1 Local Study Area

A vegetation Local Study Area (LSA) is designed to represent the diversity of vegetation in the immediate Project area and to encompass the area within which all-direct effects and some indirect effects of Project activities on vegetation are likely to occur. A vegetation map of the area is developed at a scale of 1:20,000, using aerial photography and field data (completed in 2007).

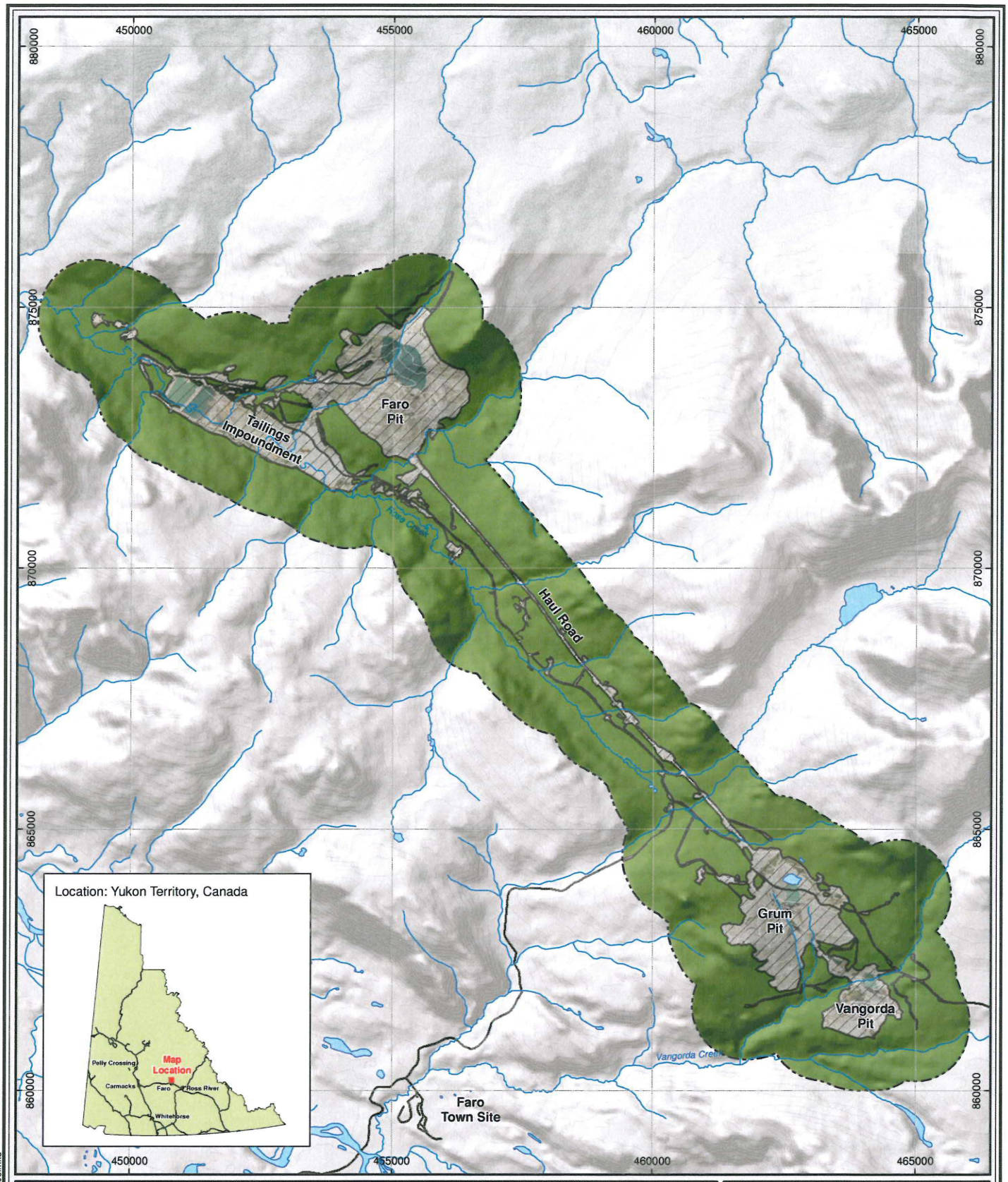
For the purposes of this project, the LSA includes the area within a 1 km wide buffer around mine facilities, infrastructure and road corridors, and covers an area of approximately 81.2 km^2. The location and extent of the LSA is represented in Figure 1.4-1.

4.2 Regional Study Area

The Regional Study Area (RSA) encompasses the area within which any regional effects of Project activities on vegetation are predicted to occur. The RSA includes the area within which accumulations of contaminants above background levels have been recorded.

4.3 Baseline Project Footprint

The baseline Project footprint includes the total current disturbance area of the proposed Project, including the Faro Mine Area, Vangorda /Grum mine area and associated infrastructure including pits, tailings impoundment, quarries, ponds and roads. The area of the baseline Project footprint is 16.1 km^2. The location and extent of the Project footprint is represented in Figure 1.4-1.



Map Sources/Notes:
National Topographic Database (NTDB) provided by the Government of Canada, Natural Resources Canada at 1:50,000 scale.
Hillshade imagery obtained from the Yukon Department of Environment, Information Management & Technology Department.
Orthophoto produced from 1:40,000 aerial photography (Aug. 9, 2003)
Local study area delineated by Gartner Lee Limited.

N
W E
S

0.5 0 0.5 1 1.5 2 2.5 Km

1:100,000

Yukon Albers

Legend

Existing Features
- Community
- Road

Elevation Contours
- Contour interval (100m)

Boundaries
- Project Footprint
- Local Study Area

Hydrological Features
- Watercourse
- Waterbody

Closure and Remediation Plan
For The Faro Mine Complex

Local Study Area and Project Footprint

06 February 2008

Gartner Lee

Figure 1.4-1
Version 1

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5. Data Sources

Data sources for the LSA are primarily Project field data collection, 1:10,000 scale black and white aerial photos and a 1:20,000 colour ortho photo of the area. Data sources for contaminant accumulation in vegetation in the RSA are primarily the results of the Anvil Range Mine Complex – Terrestrial Effects Study: Investigation into Metal Concentrations in Vegetation, Wildlife and Soils, prepared for Deloitte & Touche Inc. on behalf of the Faro Mine Closure Planning Office by Gartner Lee Limited September 2006.

References for plant species identification and nomenclature include: Flora of the Yukon Territory (Cody, 2000), Plants of Northern British Columbia (Mackinnon et. al, 1999) and Plants of the Western Boreal Forest and Aspen Parkland (Johnson et. al, 1995).

The 2007 draft revegetation program conducted by EDI was consulted for additional information regarding natural communities within the Project (EDI, 2008).

6. Baseline Description

6.1 Local Study Area

6.1.1 Local Study Area Baseline Data Collection Methods

During the summer of 2007, representative vegetation associations were surveyed in order to describe their composition and develop vegetation map units. The characteristic composition and cover of species in each association was determined through standardized plot sampling in representative areas. A preliminary vegetation map of the area was then developed at a scale of 1:20,000, using aerial photography flown in July 2003. Map units for the LSA vegetation associations map were designed to link to the existing Sheep Mountain studies (Staniforth, 1998), taking into consideration that modifications of the Sheep Mountain associations were undertaken to better represent the vegetation in the project LSA. Many potential associations are not identified for this project as they were too small to map or there was a lack of clarity in their delineations.

The vegetation sampling density for LSA mapping was guided by the British Columbia Terrestrial Ecosystem Mapping (TEM) inventory standards for 1:20,000 scale mapping (Resource Inventory Committee 1998). These guidelines provide a previously evaluated sampling strategy that is scientifically accurate and efficient, particularly for collecting data in remote locations with limited access. Data collection identified in these guidelines includes 5% detailed vegetation plots, 20% ground plots and 75% visual calls to confirm map polygon identifications.

During the 2007 vegetation field survey of the Faro LSA, 17 ground plots and 59 visual calls were inventoried (see Figure 1.6-1). A list of the sites surveyed in 2007 and their corresponding vegetation associations are presented in Appendix A.

Baseline descriptions are developed for each mapped vegetation association, including plant species composition, terrain and general soils characteristics, e.g., site moisture and nutrient regime, based on field data. No specific soil characterizations were undertaken during this investigation.

6.1.2 Local Study Area Baseline Conditions

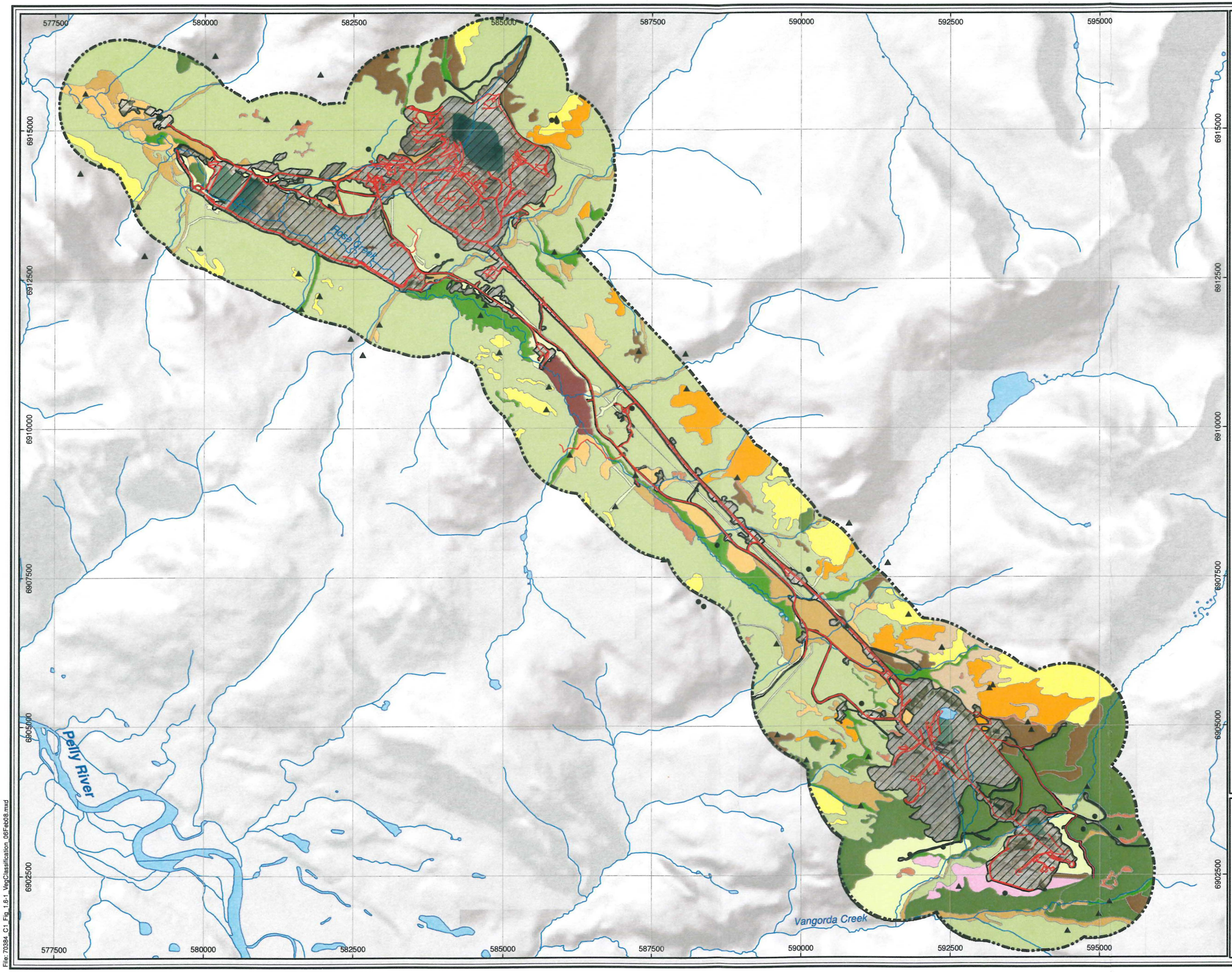
The LSA baseline conditions are generally described in relation to each issue (vegetation abundance and diversity and vegetation health), and more specifically for the VECs associated with those issues.

6.1.2.1 Vegetation Association Descriptions

Thirteen vegetation associations and the project footprint have been identified and mapped within the LSA of the project. Their distributions are shown in Figure 1.6-1. The abundance of each vegetation association and the abiotic features in the LSA are present in Table 1.6-1. The white spruce/willow vegetation association covers the largest area at 3657.4 ha (45%) of the LSA. Detailed descriptions of the vegetation associations including their component vegetation species and a representative photo are presented in Appendix B. A list of vegetation species observed during the 2007 field survey is presented in Appendix C.

Table 6-1. Faro Mine Closure Project LSA Vegetation Associations Baseline Area

Vegetation Association	LSA Map Code	LSA Baseline Area	
		Area (ha)	% of LSA
Sedge/Willow	S/W	54.6	0.7
Willow/Sedge	W/S	254.7	3.1
Willow/White Spruce	W/Sw	326.0	4.0
Willow/Dwarf Birch	W/B	182.2	2.2
Dwarf Birch/Willow	B/W	232.2	2.9
Dwarf Birch/Lichen/Subalpine Fir	B/L/Fa	357.8	4.4
Dwarf Birch/Subalpine Fir	B/Fa	279.9	3.4
White Spruce/Willow	Sw/W	3657.4	45.0
White Spruce/Feathermoss	Sw/Fm	105.1	1.3
Pine	Pl	52.4	0.6
Mixed Coniferous-Deciduous	Mx	682.0	8.4
Deciduous	Dd	276.6	3.4
Graminoid	Gr	49.3	0.6
Project Footprint	PF	1612.7	19.9
LSA Total Area		**8122.8**	**100.0**



Legend

Existing Features
- Road
- Local Study Area

Hydrological Features
- Watercourse
- Waterbody

Survey Sites (2007)
- Visual Calls
- Ground Plots

Vegetation Classification
- B/Fa
- B/L/Fa
- B/W
- Dd
- Gr
- Mx
- Pl
- S/W
- Sw/Fm
- Sw/W
- W/B
- W/S
- W/Sw
- Project Footprint

Location: Yukon Territory, Canada

Map Sources/Notes:
Base data obtained from the Yukon Department of Environment, Information Management & Technology Branch.
National Topographic Database (NTDB) provided by the Government of Canada, Natural Resources Canada at 1:50,000 scale.
Survey sites provided by Gartner Lee Limited.
Vegetation classification conducted by Gartner Lee Limited from aerial photography at 1:10,000 scale.
Local study area delineated by Gartner Lee Limited.

N W E S

0.5 0.25 0 0.5 1 1.5 2 2.5 Km

1:60,000
UTM Zone 8N, NAD 27

Closure and Remediation Plan
For The Faro Mine Complex

Vegetation Associations and 2007 Survey Sites

06 February 2008

Gartner Lee

Figure 1.6-1
Version 1

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Ecozones

Vegetation associations throughout the mapped LSA vary according to elevation, soil drainage, aspect and disturbance (Oswald *et al.*, 1983). Due to the mountainous nature of the LSA, elevation is a prominent element in determining vegetation associations. The LSA can be divided into two zones; the boreal zone and the subalpine zone.

Boreal Zone

The boreal zone contains forested, low elevation valley bottoms and low-lying terrain (Deloitte & Touche and Gartner Lee, 2003). Most waterbodies and wetlands are associated with this zone, which dominates the majority of the study area below 1200 m. This area was extensively glaciated, leaving morainal and glacial-fluvial deposits (Staniforth, 1998), and contains a large number of associations linked to terrain variation and fire.

Subalpine Zone

In the 2004 to 2008 Water License Renewal Environmental Assessment Report (Anvil Range Mining Corporation, 2003), it is stated that; "the subalpine zone refers to the one between the relatively closed-canopy forests in the boreal zone and the dwarf shrub, herb and non-vegetated rock areas in the alpine zone. The subalpine zone represents a broad gradient between low and high elevation conditions. It is dominated by tall shrub vegetation with scattered spruce and fir forests at its lower limits, grading into lower stature shrub and herb communities at upper elevations." This zone begins at roughly 1200 m and is noted as being higher on southern aspects than on northern ones (Oswald *et. al*, 1983).

6.1.2.2 Rare or Threatened Plant Species

The current regulatory lists for rare and threatened species; "Wild Species 2005: The General Status of Species in Canada" (CESCC 2006) identifies and ranks threats to plant populations on consideration for the following factors: population size, number of occurrences, geographic distribution, trend in population, trend in distribution, threats to population and threats to habitat. Rare and threatened plants include species ranked as "may be at risk" and "at risk". A third risk category, "sensitive", includes species not currently at risk or rare, but species that may be vulnerable to impacts to populations. Status rank categories are presented in Table 1.6-2. There are currently 227 "Sensitive" vascular plant species in the Yukon, 249 "may be at risk" and none are "at risk" (see Appendix D).

Table 6-2. General Status Rankings for Vascular Plants

General Status Categories*	
At Risk	Species for which a formal detailed risk assessment (COSEWIC assessment or territorial equivalent) had been completed and that have been determined to be at risk of extirpation or extinction (i.e., endangered or threatened).
May be at Risk	Species that may be at risk of extinction or extirpation, and are therefore candidates for detailed risk assessment. These species are ranked with the highest priority for COSEWIC or jurisdictional consideration.
Sensitive	Species which are not at risk of extinction or extirpation but may require special attention

	or protection to prevent them from becoming at risk. These species are ranked with a medium priority for further consideration.
Secure	Species which are not at risk or sensitive. These species have the lowest priority for further consideration.
Undetermined	Species for which insufficient information, knowledge, or data is available to reliably evaluate their general status.
Not Assessed	Species which are known or believed to be present, but which have not been examined.
Exotic	Species that have been moved beyond their natural range as a result of human activity.
Accidental	Species occurring infrequently and unpredictably, outside their usual range.

* Canadian Endangered Species Conservation Council (CESCC) 2006. Wild Species 2005: The General Status of Species in Canada.

The Yukon Conservation Data Centre under NatureServe Canada documents ranks and tracks populations of rare plant species, but does not assign a "threat or risk" status. Status rank categories are presented in Table 1.6-3. There are currently 185 "S1" vascular plant species in the Yukon, 147 "S2" species and 59 "S3" species (see Appendix D).

Table 6-3. NatureServe Yukon's Status Ranks for Rare Species

Status Categories *	
S1	≤5 occurrences or only a few remaining individuals
S2	6-20 occurrences or with many individuals in fewer occurrences
S3	21-100 occurrences may be rare and local throughout its range, or in a restricted range (may be abundant in some locations or may be vulnerable to extirpation because of some factor of its biology)
S4	Apparently secure under present conditions, typically > 100 occurrences but may be fewer with many large populations; may be rare in parts of its range, especially peripherally
S5	Demonstrably secure under present conditions, > 100 occurrences but may be rare in parts of its range, especially peripherally.
SU	Status uncertain often because of low search effort or cryptic nature of the element; possibly in peril, unrankable, more information needed.

* Yukon Department of the Environment, Fish and Wildlife Branch 2005. Yukon NatureServe.

At the federal level, species determined to be at risk (endangered, threatened or of special concern) by COSEWIC undergo a regulatory review process administered under the *Species at Risk Act* (*SARA*) (Government of Canada, 2003; CWS, 2005) for listing in Schedule 1 of the Act. There is currently one SARA-listed plant in the Yukon, *Carex sabulosa*, however it is restricted to sand dunes in south/ southwest Yukon.

No surveys for rare, threatened and sensitive vascular plants were undertaken in 2007, however they will be conducted during the 2008 growing season for all areas where new disturbance to natural vegetation is planned.

6.2 Regional Study Area Baseline Vegetation Health

6.2.1 Vegetation Health Background

As a result of concern with respect to the potential for elevated metal concentrations to occur in vegetation, soils and wildlife near the Faro Mine Complex, a Terrestrial Effects Study was completed by Gartner Lee Ltd (GLL) and associates in 2006. The overall objective of the Terrestrial Effects Study was to gather data that could be used to better understand the distribution and movements of elevated elemental concentrations in the terrestrial environment. Such information could then be used for a future human and ecological risk assessment (HHERA). The specific objectives of this study were to:

- characterize the spatial distribution of elevated elemental concentrations,
- determine if deposition is ongoing,
- improve characterization of elemental concentrations in reference materials,
- investigate elemental concentrations in vegetation and mineral licks,
- investigate elemental concentrations in wildlife tissues,
- determine specific sources of elemental lead, and
- determine elemental concentrations in ambient air.

The findings of this study with respect to vegetation health are presented in the following sections. Although the Terrestrial Effects Study was designed to provide an understanding of the spatial extent, timing and concentrations of elements in the terrestrial environment near the Faro Mine Complex, it does not deal with the significance of these findings in terms of human health and ecological risk.

6.2.2 Vegetation Health Baseline Data Collection

Several interrelated environmental parameters were examined to obtain the data needed for the terrestrial effects assessment. The study design applicable to vegetation health is summarized below. Further detail on study design and methods is contained in the GLL *et al* 2006 report.

6.2.2.1 Characterization of the Spatial Distribution of Elevated Elemental Concentrations

To isolate the effects of airborne deposition from mineralization, the spatial distribution of elevated elemental concentrations was determined, primarily by sampling lichens. Lichens (*Cladina spp.*) were selected as the indicator species because they are long-lived, non-deciduous and depend entirely on airborne material and precipitation for nutrients and are therefore unaffected by the mineralization of underlying soils. Soils are also perennial accumulators and provide an additional record of cumulative airborne deposition; however, elemental concentrations in mineral soils can also be influenced by natural mineralization and glacial transport. Soil sampling was therefore conducted to:

- confirm the results of lichen sampling, and
- detect naturally elevated elemental concentrations (i.e., unrelated to the mine) in local surficial materials.

6.2.2.2 *Timing of Deposition of Mine-Related Dust*

Initial studies conducted in 2002 (C.E. Jones & Associates Ltd. 2003) indicated that elemental deposition occurs in the study area from operations at the mine but did not provide information about its timing. Studies were conducted in 2004 and 2005 to determine if deposition is ongoing. This study component was designed to determine if measured elemental concentrations are at their maxima or will continue to increase into the future. Moss bags were used to determine if airborne deposition is ongoing and its timing.

6.2.2.3 *Elemental Concentrations in Vegetation and Mineral Licks*

Selected plant species were collected in the study area to determine the uptake of various elements by vegetation used by wildlife (e.g., forage species) or humans (e.g., medicinal use or ingestion). However, elemental concentrations in vascular (i.e., rooting) vegetation can be influenced by both pre-existing mineralization (elemental uptake via root systems) and by airborne elemental deposition (through deposition on plant surfaces and uptake through surface soil). To distinguish between these sources and ensure that elevated concentrations were not erroneously attributed to mine operations, soils were collected, subsampled and analyzed where plants important to wildlife or humans were collected. Soil was also collected at mineral licks because wildlife using licks may consume soils either directly or indirectly through the ingestion of soils while foraging, providing a potential secondary source of elemental uptake. These study components provide information about elevated metal concentrations in the human and wildlife food chains and will assist in predicting potential impacts on local land-users from elevated metal concentrations resulting from care and maintenance operations at the mine.

6.2.2.4 *Sources of Elevated Lead Concentrations*

Potential mechanisms for the dispersal of elements in the Faro Mine Complex study area include windblown dusts and a historic spill of tailings into Rose and Anvil Creeks, which drain portions of the Faro Mine Complex. The potential for lead from naturally occurring and outside sources to affect the study area required that local "background" levels were distinguishable from those resulting from the Faro Mine Complex. Lead (Pb) isotope tracing was used to determine the origin of lead in samples of dust, soils and moss bags from the study area. The analysis was conducted to:

- Identify and quantify ore deposit leads in dusts and soils from the Faro Mine Complex,
- Distinguish and quantify lead from mine ores and from long-range lead sources in airborne dust at locations on and off of the mine site, and
- Determine whether tailings from a historic spill are present in the floodplains of Rose and Anvil Creek below the mine.

6.2.3 Vegetation Health Baseline Conditions

The information collected in the terrestrial environment shows that past operations at the Faro Mine Complex have resulted in metal concentrations in the mine area that are greater than the reference/background levels. For example, lead concentrations near the mine are up to 450 times those at reference sites and the lead isotope analysis indicates that the majority of the lead

deposited in the study area was from mine ores. The concentrations of metals that originated from the mine site are generally higher near the mine and decline with distance from the mine. Deposition of some metals from the mine site is still occurring in the immediate area, mostly during the snow-free period. Metal concentrations that were greater than the reference/background levels were detected in plants, small mammals and other wildlife in the area.

The discussion of the results for each component of this study is presented below.

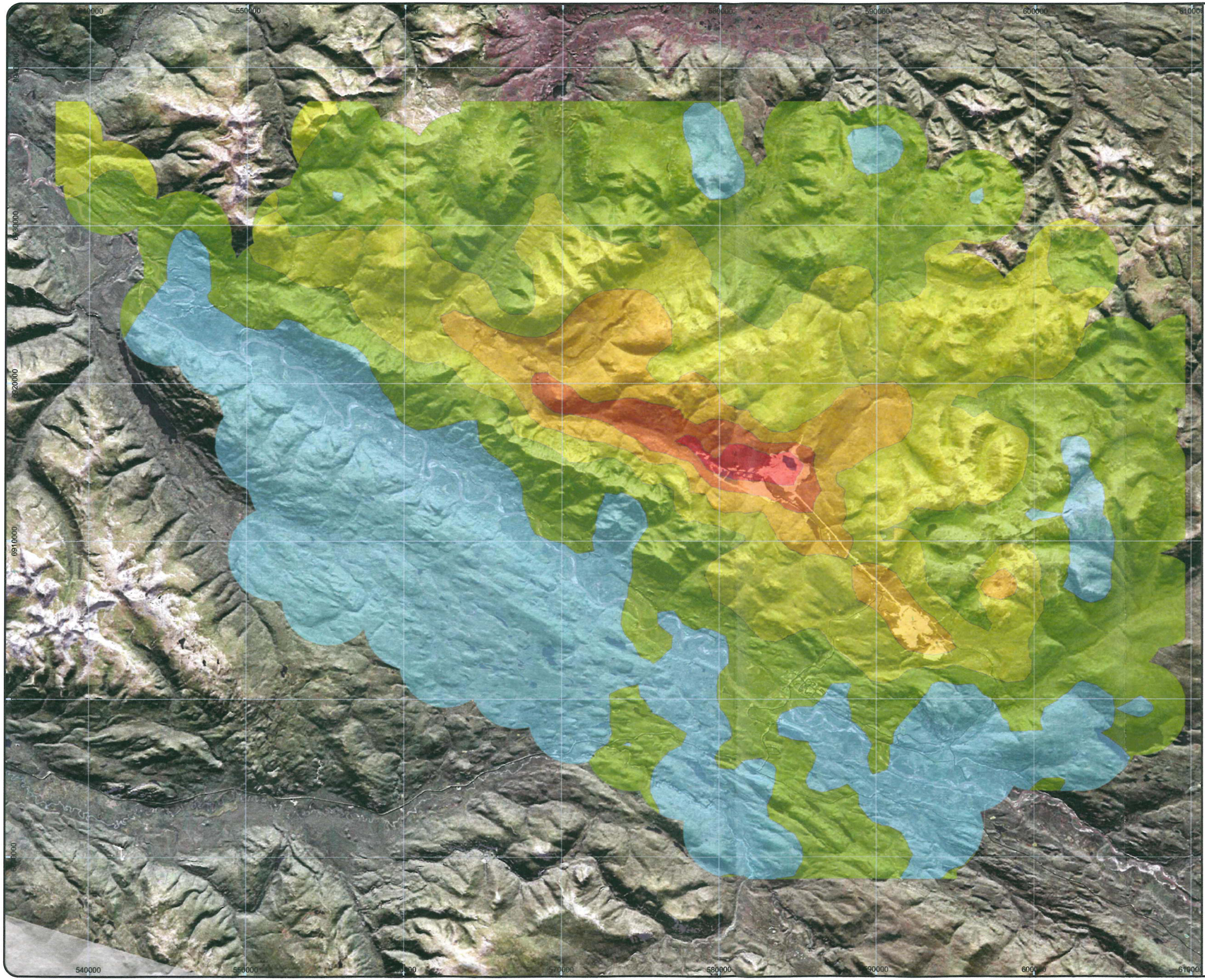
6.2.3.1 Characterization of the Spatial Distribution of Elevated Elemental Concentrations

Because lead is the least mobile of the "heavy" metals (as opposed to zinc, which can be highly mobile in both soils and plants), it likely represents the best historical record of elevated elemental levels resulting from operations at the Faro Mine Complex. Lead in lichen tissue was therefore considered the principal indicator of the spatial distribution of elevated elemental levels from the Faro Mine Complex. High lichen lead levels in the integrated 2002 / 2004 / 2005 data set are evidence of significant mine-generated accumulations. Some lead levels near the Faro tailings impoundment / mill complex were 150-450 times baseline values.

The zone of elevated concentrations (Figure 1.6-2 (14 from the original report)) extends to the Blind Creek Valley / Swim Lake basin to the southeast (1-10 km from the Grum / Vangorda mine areas), to the Pelly River Valley to the southwest (5-10 km from the mine site) and a minimum of 20 to 25 km from the mine complex up the North Fork Rose Creek drainage. Elevated concentrations of elements also extend a minimum of 40 to 50 km from the mine complex down the Rose / Anvil / Pelly drainages; however, the 1975 tailings dam breach may have contributed to the extent of the area of impact in this direction. Lichen lead levels measured at several locations in the study area are higher than published reference levels for lichens, and are comparable to some of the higher levels documented worldwide in vascular vegetation at sites contaminated with lead. Although the area sampled for lichens was expanded in the 2004 and again in 2005, the maximum spatial extent of elevated lichen-lead concentrations could not be determined for all directions from the mine.

Soils were also examined to determine if elevated elemental levels could be attributed wholly or partly to the influence of underlying mineralized soils. Although patterns for lead and zinc in surface soils are similar to those for lichens, no similar pattern exists in subsurface organic or mineral soils. Furthermore, there is no apparent relationship between concentrations in underlying materials and surface horizons. These findings support the hypothesis that the spatial pattern of elevated elemental levels has been caused by deposition from the Faro Mine Complex and cannot be attributed to natural effects that predate mining.

The lead isotope analysis of dust, soil and moss samples from the study area further supports the conclusion that elevated elemental levels are caused by the mine. In addition, sequential extractions performed on a subset of soil samples indicate that substantial fractions of total lead concentrations exist in a weakly complexed form, which becomes relatively mobile when associated compounds decompose or degrade. The implications are that lead deposited from the mine site is not environmentally inert. Instead, it can be expected to have some mobility through plant uptake and leaching through to lower soil horizons, where it will likely become more permanently fixed. Following is a summary of results.



LEGEND

Lead Concentration (ppm)

0.2 - 1.6	Zone 1
1.6 - 4.6	Zone 2
4.6 - 17	Zone 3
17 - 61	Zone 4
61 - 210	Zone 5
210 - 748	Zone 6
Road	

DATA SOURCES AND DISCLAIMERS:

Kriging surfaces compiled by Gartner Lee Ltd. Kriging is an interpolation technique based upon a generalized least-squares algorithm using distance-variance relationships as weighting functions. It is used to produce unbiased estimates of concentrations in unsampled areas. The prediction is constrained to one-third of the total prediction standard error.

Updated Road Network compiled by Government of Canada, Natural Resources Canada (NRCan).

Shaded relief colour orthorectified image at 15m resolution compiled by Yukon Territorial Government, Dept. of Infrastructure, Yukon Geomatics, from Landsat 7 image 59-16, bands 3, 2, & 1.

Created By: AS/EG

Reviewed By: MG/DS

Date Issued: March 2006

Project Number: 50712

File Name:S:\GIS_Proj\Y2005\P 50712\report_mar06\50712_lead_lichen_11x17_fig14.mxd

Revision: 1

Projection: UTM Zone 8 NAD83

0 2 4 8 12
Kilometers

Scale 1: 225 000

Deloitte.

Project: Anvil Range Project 17a Terrestrial Effects
Location: Faro Mine Site, Yukon
Client: Deloitte & Touche Inc.

Standard Geostatistical Kriging of Lead in Lichen

Gartner Lee | JONES

Figure No. 1.6-2

- **High Elevation Relative to Reference Levels – Lead and Arsenic.** Maximum lead and arsenic concentrations in areas affected by the mine were 450 and 250 times the Swim Lake maximum, respectively. Equivalent-to-reference levels were reached to the southwest of the mine site, across the Rose mountain range, and around the perimeter of the study area from the southeast to north. To the northeast and northwest, however, equivalent-to-reference concentrations are at least 20 to 25 km and 40 to 50 km, respectively, from the Faro mine area. The total area in which lead concentrations in lichens are at least 3 times the observed Swim Lake maximum is approximately 769 km2 (76,900 ha).
- **Moderate Elevation Relative to Reference Levels – Zinc, Copper, Iron, Silver, and Thallium.** Maximum concentrations of these elements in areas affected by the mine were 15 to 75 times higher than Swim Lake maxima. Equivalent-to-reference concentrations were generally reached at distances of 0 to 2 km from the Vangorda / Grum mine areas, to the northeast along the exposed (mine-side) slopes of Mount Mye, and to the southwest along the exposed slopes of Rose Mountain. Elevated elemental levels generally extend to the northeast along North Rose Creek, to the north up and past Mount Aho, and to the northwest down the Rose Creek valley.
- **Low Elevation Relative to Reference Levels – Barium, Chromium, Mercury, Nickel, and Selenium.** Maximum concentrations for most of these elements in mine-affected areas were three to nine times the Swim Lakes maxima and zones of elevated elemental levels are generally smaller than those for lead and other elements in the High and Moderate categories. Although selenium concentrations near the mine were 25 times the Swim Lake maximum, this element has been placed in the "low elevation" category because the area affected by elevated concentrations is very small.
- **Marginal Elevation relative to Reference Levels – Antimony, Cadmium, and Cobalt.** There is some evidence that elevated concentrations of these elements are associated with the Faro Mine Complex. Concentrations of these elements, however, are either within reported Yukon reference ranges for lichens (antimony and cobalt), or are similar to other high levels in the study area that appear to be unrelated to the presence of the mine (cadmium).
- **No Elevation Relative to Reference Levels – Boron, Molybdenum, Titanium, Vanadium, Aluminum, Beryllium, Calcium, Magnesium, Manganese, Phosphorus, Potassium, Silicon, Sodium, Tellurium, Tin and Uranium.** Elevated concentrations of these elements either occurred in areas that were not affected by the mine or else there was no apparent pattern of elevated levels. Consequently, elevated concentrations of these elements cannot be attributed to operations at the Anvil Range Mine.

6.2.3.2 Timing of Deposition of Mine-Related Dust

The exposure of moss bags for different time periods from August 2004 to August 2005 indicated that mine-generated deposition for a number of elements is ongoing. Lead had the highest amount of deposition and the pattern was generally similar to that for accumulated lead levels in lichens (i.e., elevated levels are concentrated in the vicinity of the tailings impoundment / mill complex and northwest down the Rose Creek valley). The results of the moss bag monitoring program indicate that over the study period, deposition occurred primarily between August and November, and again

between late January and mid-August. This suggests that deposition occurs primarily during the snow-free period.

Concentration patterns of elements other than lead in moss bags are somewhat different from the observed cumulative patterns recorded for lichens. For example, arsenic has the second highest cumulative elemental concentration in lichens relative to reference levels but there appears to be little current deposition. In contrast, barium and nickel accumulations in lichens are low but these elements were among those with high levels of deposition in moss bags. Furthermore, aluminum, manganese, silicon, and uranium levels were elevated in moss bags but there was no evidence of mine-generated accumulations in lichens. Disparities between observed cumulative elemental elevation and current elemental deposition suggest that:

- the contribution of current mine-site elemental dust sources is different than historical contributions, due to different operational and closure conditions; and / or
- the period monitored by moss bag exposure does not reflect the entire range of conditions that have contributed to cumulative elemental elevation in the study area.

Moss bags are useful indicators of current airborne deposition and can also provide a general indication of where sources of deposition are located. However, they do not indicate specific sources or provide empirical measurements of ambient elemental concentrations in the air. Consequently, lead isotope analysis and ambient air-sampling using mini-vols was conducted in 2005.

Elemental Concentrations in Vegetation and Mineral Licks

- **High Elevation Relative to Reference Levels – Lead.** Lead concentrations for all plant species groups were greatly elevated in the zone immediately adjacent to the tailings impoundment / mill complex, which indicates that the presence of the mine has affected lead concentrations in vascular plants and mushrooms as well as in lichens and soils. Lead levels near the mine, ranged from 2.5 (horsetails) to 410 (tree sap) times Swim Lake reference means. Willows, grasses, forbs, horsetails, mushrooms and bear root all had lead levels above reference ranges. There are no reference levels for comparison for tree sap.
- **Moderate Elevation Relative to Reference Levels – Zinc.** Zinc levels were significantly elevated in berries, willows and forbs collected next to the tailings impoundment / mill complex. The magnitude of elevation ranged from three times the Swim Lake reference mean for berries to 20 times for forbs. In most zones affected by the mine, zinc levels in forbs, willow, mushroom and bear roots exceeded documented Yukon background ranges.
- **Low Elevation Relative to Reference Levels – Copper, Nickel, Silver, Mercury and Thallium.** These elements all had isolated occurrences of significantly elevated concentrations compared to Swim Lake reference levels. Concentrations ranged from approximately two (copper in willows) to nine times (silver in willows and thallium in Labrador tea) Swim Lake reference means. It should be noted, however, that for lichens, there was no conclusive evidence of a link between elevated nickel levels and the Anvil Range mine.

There is some evidence that concentrations of antimony, arsenic, barium, cadmium, chromium, cobalt, iron and mercury are elevated in northern rough-stemmed mushrooms, bear root and tree sap collected in mine-affected areas compared to Swim Lake or Yukon reference levels. Most notably, maximum arsenic concentrations in northern rough-stemmed mushroom and tree sap in mine-affected areas were 11 times reference levels and maximum iron concentration in tree sap was 22 times reference levels.

Soil samples were collected from two mineral lick sites, one in the vicinity of the Faro Mine Complex (Mineral Lick Site 2) and one within a reference area (Mineral Lick Site 1). The analysis of soils collected at Mineral Lick Site 2, which is within lichen lead zone 2, indicates that there is potential for the ungulates to consume soils containing marginally elevated levels of mine-related elements, particularly lead; however, the effect of the mine is expected to be small. Lead levels at Mineral Lick Site 2 are no higher than Swim Lake or published maxima.

6.2.3.3 Sources of Elevated Lead Concentrations

The results of the lead isotope study indicate that ore from the Faro Mine Complex is by far the most important source of lead deposition in the study area. Although lead from the ore is mixed with non-ore lead in some areas, lead from the ore is widespread in the study area and often comprises over 90% of that found in both soils and moss bags. Lead from Faro Mine Complex ores is also comprises 60 to 90% of the lead found in soils at sampling sites in the Anvil Creek floodplain.

Lead that occurs in floodplain soils is probably largely the result of the tailings dam breach, which occurred in 1975. Moss bag sampling indicated that mine ores are the source of almost 100% of the lead that is currently being deposited in the study area.

Moss bags at all sampling sites contained lead from mine ores. Such sites included those near the Town of Faro and in the Swim Lake reference area; however, lead concentrations in moss bags in those areas were low.

6.2.4 Vegetation Baseline Summary

6.2.4.1 Vegetation Cover Baseline Summary

A 81.2 km^2 vegetation LSA was established to map the distribution and diversity of vegetation associations in the Project area. The LSA includes the area within a 1 km wide buffer around mine facilities, infrastructure and road corridors. A vegetation map of the area was developed at a scale of 1:20,000, using aerial photography and field data.

Vegetation associations in this mountainous area include forested and wetland associations in the low elevation valley bottoms and low-lying terrain of the boreal zone, below 1200 m. The boreal zone contains a number of associations linked to morainal and glacio-fluvial terrain and influenced by fire. Closed forests of white spruce/willow cover the largest portion 45% of the LSA. There are

small areas of pine, mixed coniferous-deciduous and deciduous forests. Also present are shrub associations of dwarf birch and willow. Poorly drained lowland sites support dwarf birch, willow, sedge and graminoid associations. The areas of the Project LSA above 1200 m are in the subalpine zone, which is dominated by tall shrub vegetation. Scattered open spruce and fir forests occur at the lower limits, grading into lower stature shrub, herb and lichen communities at upper elevations.

Native vegetation has historically been removed from a 1612.7 ha (16.1km2) area by the development of the Faro Mine Complex.

There are currently no records for rare or at risk plant species in the Project LSA. Surveys for rare vascular plant species will occur in any areas where new disturbance to previously undisturbed native plant communities is planned.

6.2.4.2 Vegetation Health Baseline Summary

The results of the terrestrial effects study for the Faro Mine Complex show clearly that the presence of the mine has resulted in elevated concentrations of several elements both at the mine site and in the surrounding area. For example, lead concentrations in lichens near the mine were up to 450 times those in reference samples. A lead isotope analysis showed that a large proportion of the lead found in terrestrial media in the study area is from mine ores; this is the case for 61 to 100% of the dusts and soils collected from the study area, and 65 to 90% of the soils collected along Anvil Creek. In addition, the study showed that over 90% of the lead currently being deposited in the study area is from mine ores. Thus, very little of the deposited lead is transported from outside sources. Other lines of evidence confirm that the mine is the principal source of elevated elemental concentrations. Geo-statistical analyses indicated that most elements had distinct patterns of elevated concentrations, with the highest levels occurring near the mine and decreasing as distance from the mine increased. The analysis of soils indicated that elemental concentrations in vegetation and surficial soils were not related to the degree of mineralization in underlying soil horizons.

The area affected by some elements is large. For example, concentrations of lead are elevated in an area that is known to be at least and which is probably greater than 1,760 km2. The study, however, was unable to delineate the entire area in which concentrations of some elements are elevated despite expanding the sampling program in 2004 and again in 2005. For example, the limit of deposition for lead is not known for the area to the northwest and northeast, which includes the Rose, Anvil and Pelly drainages, although it is believed to extend 40 or 50 km from the mine. Similarly, the limit of elevated lead concentrations is unknown in the area to the north and east of the mine; however, the data suggest that lead concentrations in this area are likely to approach background levels approximately 20 km away. In contrast, lead is known to decline to background levels approximately 5 to 10 km to the south of the Anvil Range Mine complex.

Although the mine appears to be the source of almost all elevated elements detected in the study area, two distinct sources are associated with the mine and mining operations. The mine itself is

the source of most elemental deposition; however, a breach of the tailings dam in 1975 resulted in the deposition of tailings along watercourses to the northwest of the mine site. These tailings deposits, which occur discontinuously, may provide a secondary source of water- and air-borne deposition, which could extend the area affected by elevated elemental concentrations. Moreover, there is potential for the affected area to continue to expand as a result of the fluvial and airborne transport of tailings materials.

The presence of elevated elemental concentrations in plants consumed by humans and animals indicates that these elements are entering the environmental food chain and also have the potential to be incorporated into the human food chain.

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8. Glossary and Abbreviations

8.1 Glossary

Biodiversity	The variety of life, from genes and species to communities, ecosystems, functions, and processes
Critical levels	The concentration of pollutants in the atmosphere above which direct adverse effects on receptors such as plants and ecosystems may occur according to present knowledge. Critical levels relate to direct effects on plant physiology, growth and vitality and are expressed as atmospheric concentrations or cumulative exposures over a given period of time (WHO, 2000).
Critical load	A quantitative estimate of an exposure in the form of deposition for one or more pollutants, below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge. Critical loads relate to ecosystem structure and functioning and are expressed as annual depositions of mass or acidity. Typically, critical loads relate to the potential effects over periods of decades.
Ecosystem	An integrated and stable complex of living organisms and the non-living components of their environment, functioning together to circulate nutrients and create energy flow.
Environmental receptors	Living and non-living components of the environment that can absorb pollutants.
Ericaceous shrub	Low woody shrubs that are part of or related to the heather family (*Ericaceae*)
Exotic	A species that has been moved beyond their natural range as a result of human activity.
Forb	A non-woody, leafy plant not related to the grass-like plants.
Herbaceous	Non-woody

Indicator	A measurable parameter through which change can be measured.
Phenology	The seasonal timing of growth, flowering, maturation and death related to changes in light, temperature, etc.
Riparian	The area adjacent to and influenced by a water body such as a river
Senescence	The process of aging, such as occurs in shrubs before they shed leaves
Stomata	Microscopic pores in the outer layer of leaves and stems used for gas exchange.
Substrate	An abiotic material or physical surface
Threshold	A level beyond which unacceptable change may occur.
TSP	Total suspended particulate matter (dust) - refers to all particles in the atmosphere. Particles can range in size from 0.005 - 500 micrometers or microns
Understorey	Vegetation layers beneath the canopy layer.
Valued Ecosystem Component (VEC)	Characteristic or feature that represents important environmental components of an ecosystem.
Vegetation Association	Homogeneous groupings of vegetation identifiable on aerial photos and of sufficient size to map at a 1:20,000 scale, often linked with particular substrates, moisture regimes, nutrient regimes and terrain.

8.2 Abbreviations

CESCC	Canadian Endangered Species Conservation Council
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
ha	Hectare
km	Kilometre
µg	Microgram
LSA	Local Study Area
m	Metre
RSA	Regional Study Area
SARA	Species at Risk Act
TSP	Total suspended particulate (dust)
VEC	Valued ecosystem component
WHO	World Health Organization
Zn	Zinc

Appendix A

Vegetation Associations Surveyed in 2007

Vegetation Associations Surveyed in 2007

Survey Site	Surveyed Vegetation Association	Mapped Vegetation Association
1	Sw/Fm	Sw/Fm
2	W/B	W/B
3	Sw/W	Sw/W
4	Sw/W	Sw/W
5	B/L/Fa	~
6	W/Sw	W/Sw
7	B/L/Fa	~
8	Sw/W	Sw/W
9	W/S	W/S
10	B/L/Fa	B/L/Fa
11	B/L/Fa	B/L/Fa
12	W/S	Sw/W
13	B/L/Fa	~
14	B/Fa	~
15	S/W	W/S
16	W/S	W/S
17	W/S	W/S
18	SW/W	B/L/Fa
19	B/Fa	B/L/Fa
20	B/L/Fa	B/L/Fa
21	W/S	~
22	Sw/W	~
23	B/Fa	~
24	B/Fa	B/W
25	B/Fa	~
26	S/W	S/W
27	S/W	Sw/W
28	Mx	~
29	B/W	B/W
30	B/Fa	~
31	B/L/Fa	B/Fa
32	S/W	S/W
33	B/Fa	~
34	W/SW	~
35	W/S	~
36	Sw/Fm	Sw/Fm
37	W/SW	W/SW
38	Sw/Fm	Sw/Fm
39	S/W	S/W
40	B/W	B/W
41	Mx	Mx
42	Mx	Mx
43	W/S	W/S
44	Mx	Mx
45	Sw/W	Sw/W
46	Pl	Pl

47	Dd	Dd
48	W/Sw	Footprint
49	W/S	W/S
50	S/W	W/S
51	B/Fa	B/Fa
52	B/L/Fa	Mx
53	B/W	B/W
54	B/L/Fa	B/L/Fa
55	Sw/W	Sw/W
56	B/L/Fa	~
57	Sw/W	~
58	Sw/W	~
59	Dd	Dd
60	W/S	W/S
61	B/Fa	B/L/Fa
62	B/L/Fa	B/L/Fa
63	Sw/W	Sw/W
64	Sw/W	Sw/W
65	W/S	~
66	Sw/W	Sw/W
67	Mx	Mx
68	Pl	Pl
69	Dd	Dd
70	Sw/Fm	Sw/W
71	Sw/W	Sw/W
72	Sw/W	Sw/W
73	Sw/W	Sw/W
74	Sw/W	Sw/W
75	W/S	W/S
76	W/S	Footprint

Note:

1. '~' indicates that the survey site was outside of the LSA and therefore was not mapped.
2. There may be discrepancies between the site call for the vegetation association and the polygon label on the map. Often, many associations were too small to map so were labeled the same as the surrounding homogeneous vegetation association.

Appendix B

Vegetation Association Descriptions for the Faro Local Study Area

Sedge/Willow (S/W)

This wetland association is common in both the boreal and subalpine zone and occurs in (moist/wet) depression or drainage areas where water collects either above or below the ground, due to bedrock or soil conditions. Wetlands are defined as being "waterlogged soils where in some cases the production of plant materials exceeds the rate of decomposition" (National Wetlands Working Group, 1988). Soils are saturated for enough time that excess water and low soil oxygen levels are the main determinants of soil and vegetation development (MacKenzie and Moran 2004). Wetlands, including streams and fens, are common in low gradient valleys and catchment basins in the Faro LSA (Oswald et. al, 1983). A mixture of sedge and graminoid species dominates the area, with water sedge (*Carex aquatilis*) being most common. Shrubs such as willows (*Salix spp.*), dwarf birch (*Betula glandulosa*) and some white spruce (*Picea glauca*) are also present around the edges of the wetland. Wetland mosses such as sphagnum (*Sphagnum spp.*) are also abundant.

Photo 1. Sedge/Willow association

Willow/Sedge (W/S)

The willow/sedge association is linked with standing or flowing water, usually along lakes, ponds and creek drainages. It is a common riparian vegetation association found over a wide elevation range throughout the study area. Various willow species including tea-leaved willow (*Salix planifolia*) and Athabasca willow (*Salix athabascensis*) are dominant in the shrub layer though dwarf birch and shrubby cinquefoil (*Potentilla fruticosa*) may also be present. Shrub heights vary depending on water availability and exposure to wind and snow, but are generally 0.5 to 1 m tall. Sedge species (*Carex spp.*) such as water sedge are common below the shrub layer along with various wetland mosses (*Sphagnum spp*).

Photo 2. Willow/Sedge association

Willow/White Spruce (W/Sw)

The willow/white spruce vegetation association is often found in a riparian drainage or draw, along creeks or rivers primarily in the boreal zone. An open canopy of mature white spruce is scattered among a well-developed shrub layer dominated by various willow species and dwarf birch. Ground cover is often a combination of ericaceous shrubs, sedge species, lichens and mosses. Such species include arctic bearberry (*Arctostaphylos rubra*), net-veined willow (*Salix reticulata*), common horsetail (*Equisetum arvense*) and bluegrasses (*Poa spp.*).

Photo 3. Willow/White Spruce association

Willow/Dwarf Birch (W/B)

This riparian vegetation association is widespread in lower elevations, occurring on gentle to steep slopes near drainages or open water in the boreal zone. Willow species and dwarf birch are codominant in a well-developed shrub layer wherein willows can reach up to 4 m. Scattered young white spruce trees are common, along with low shrubs such as Labrador tea (*Ledum groenlandicum*), as well as sparse grasses and forbs. Moss and lichen cover varies depending on water and nutrient availability.

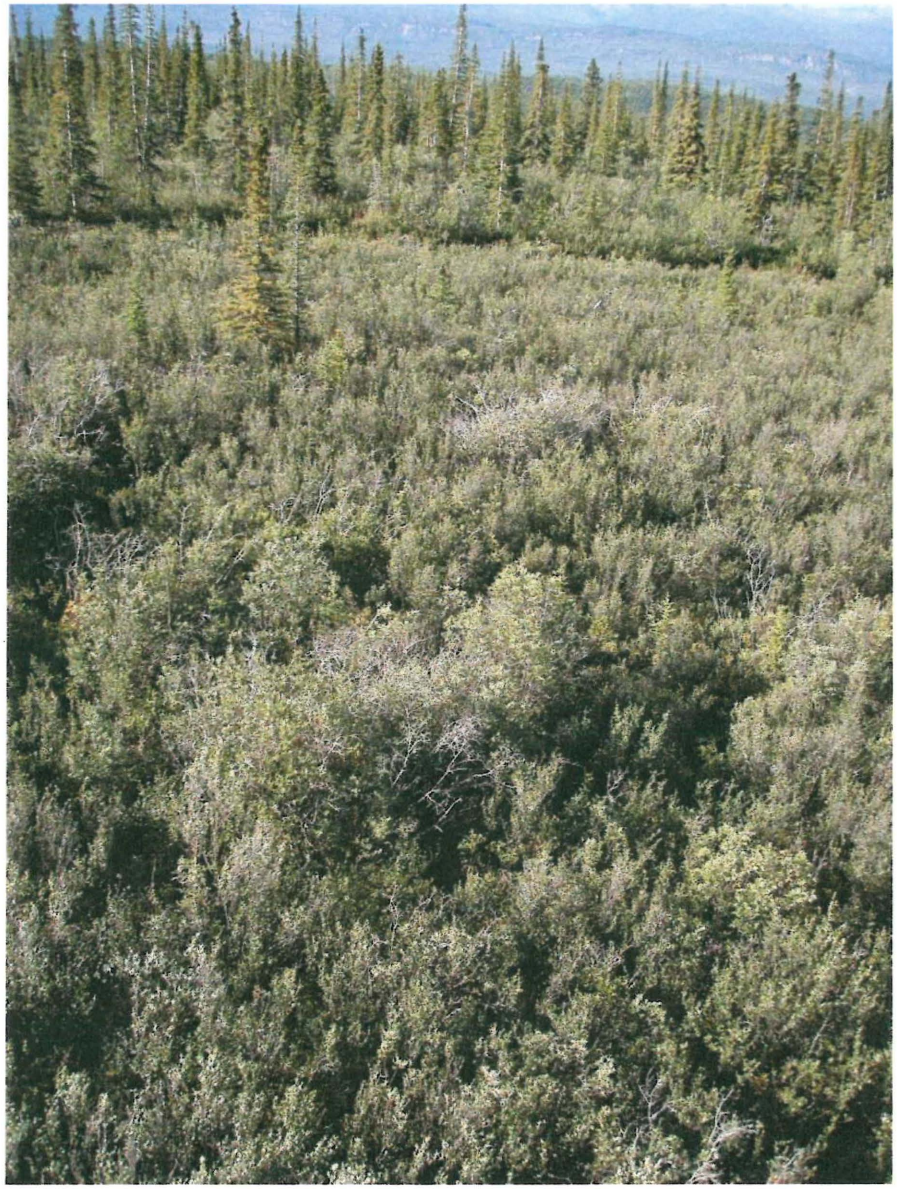

Photo 4. Willow/Dwarf Birch association

Dwarf Birch/Willow (B/W)

The birch/willow vegetation association is characteristic of slopes at higher elevations in the subalpine zone throughout the study area. Dwarf birch is the dominant shrub, however willow species, Labrador tea, shrubby cinquefoil and bog bilberry (*Vaccinium uliginosum*) are also present. A variety of ground shrubs such as crowberry (*Empetrum nigrum*), mountain cranberry (*Vaccinium vitis-idaea*) and alpine bearberry are found in the understory, however lichens (*Flavocetraria spp.*, *Cladina spp.* and *Stereocaulom spp.*) tend to dominate the groundcover. Krummholtz subalpine fir (*Abies lasiocarpa*) and white spruce occur occasionally.

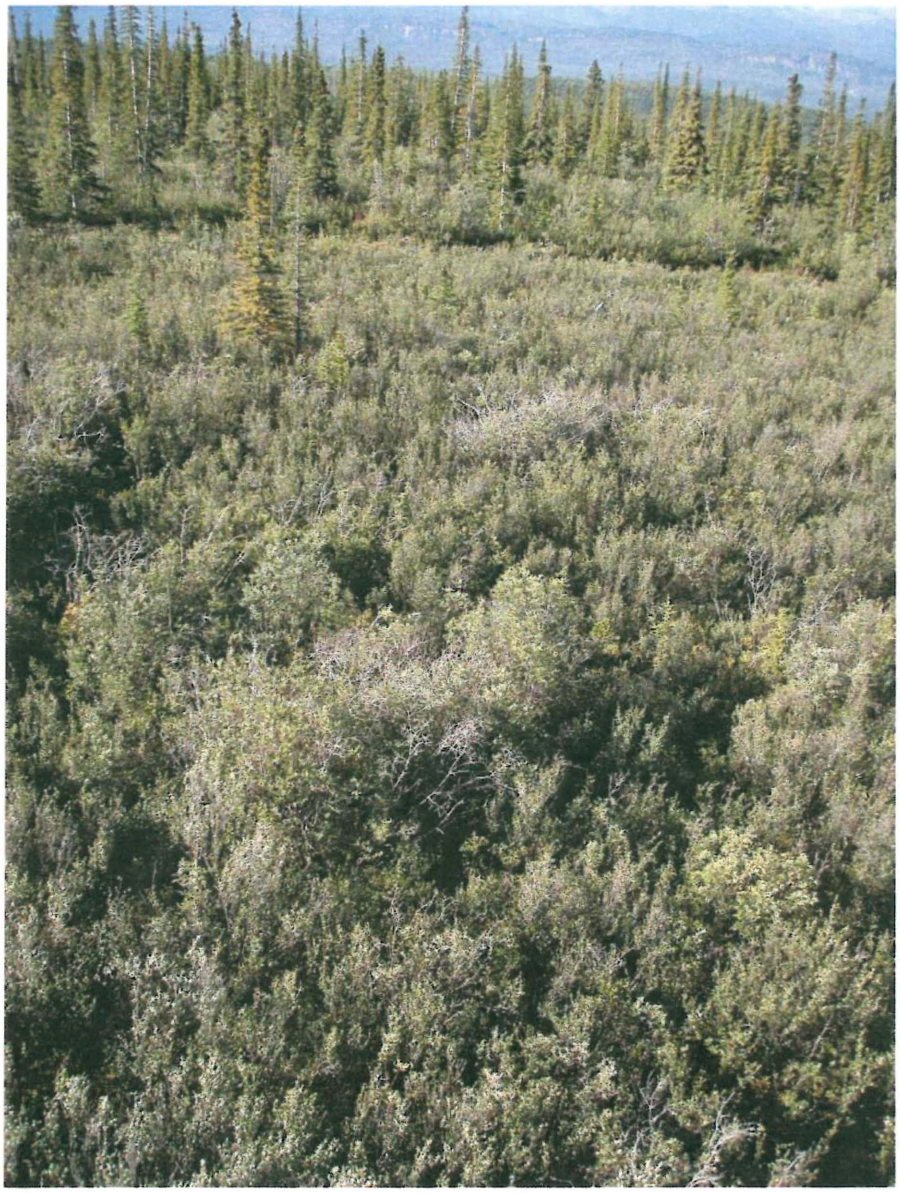

Photo 5. Dwarf Birch/Willow association

Dwarf Birch/Lichen/Subalpine Fir (B/L/Fa)

This vegetation association is a subalpine/alpine community characterized by rocky outcrops and windswept ridges at higher elevations. Dwarf birch is the dominant cover species at a height of 0.5 m tall, followed by a high cover of lichen species (*Cladina spp.*, *Stereocaulon spp.*, *Flavocetraria spp.*) intermixed with rocky outcrops. Krumholtz subalpine fir is the dominant tree species scattered throughout the vegetation association, although white spruce may also be present. Arctic bearberry, crowberry, bog bilberry and mountain avens (*Dryas spp.*) are also present.

Photo 6. Dwarf Birch/Lichen/Subalpine Fir association

Dwarf Birch/Subalpine Fir (B/Fa)

The birch/fir vegetation association is a subalpine community occurring on well-drained soils and slopes at higher elevations. Dwarf birch is the dominant cover species at a height of 0.5 to 1 m tall with scattered subalpine fir as the dominant tree species at 2 – 6 m tall. Willow species, Labrador tea, mountain juniper (*Juniper communis*) and white spruce may also be present. Low growing shrubs include bog bilberry, arctic bearberry, crowberry and mountain cranberry. Graminoid species are present in the ground cover along with various lichen species (*Cladina spp.*, *Stereocolun spp.*, *Peltigera spp.*).

Photo 7. Dwarf Birch/Subalpine Fir association

White Spruce/Willow (Sw/W)

The white spruce/willow association is the most frequent vegetation association within the study area, occurring in both the boreal and the subalpine zones on various upland and lowland slopes. White spruce dominates the tree canopy, though subalpine fir may also be present. A well-developed shrub layer is dominated by a high cover of 1 m tall willow species, along with a lower percent of dwarf birch, Labrador tea and shrubby cinquefoil. Dwarf shrubs in the ground cover layer include bog billberry, common bearberry (*Arctostaphylos uva-ursi*), net-veined willow and crowberry. Common horsetail and bluegrass species are also frequent. Stair step moss (*Hylocomium splendins*), reindeer lichens (*Cladina rangifera*) and pelt lichens (*Peltigera spp.*) are common throughout the vegetation association.

Photo 8. White Spruce/Willow association

White Spruce/Feather moss (Sw/Fm)

This vegetation association occurs most frequently on well-drained alluvial flats as well as on mesic sites in lowland areas throughout the boreal zone. The tree canopy is comprised of dense white spruce trees with a sparse shrub understory. Tall shrubs consist of willow species, dwarf birch and shrubby cinquefoil whereas low growing shrubs consist of mountain cranberry, bog bilberry, alpine bearberry and crowberry. Vegetation in the herbaceous layer includes arctic lupine (*Lupinus arcticus*), alpine sweet vetch (*Hedysarum alpinum*), purple-leaved willow-herb (*Epilobium ciliatum*) and bluegrass species. A thick carpet of feathermosses such as stair step moss is also present.

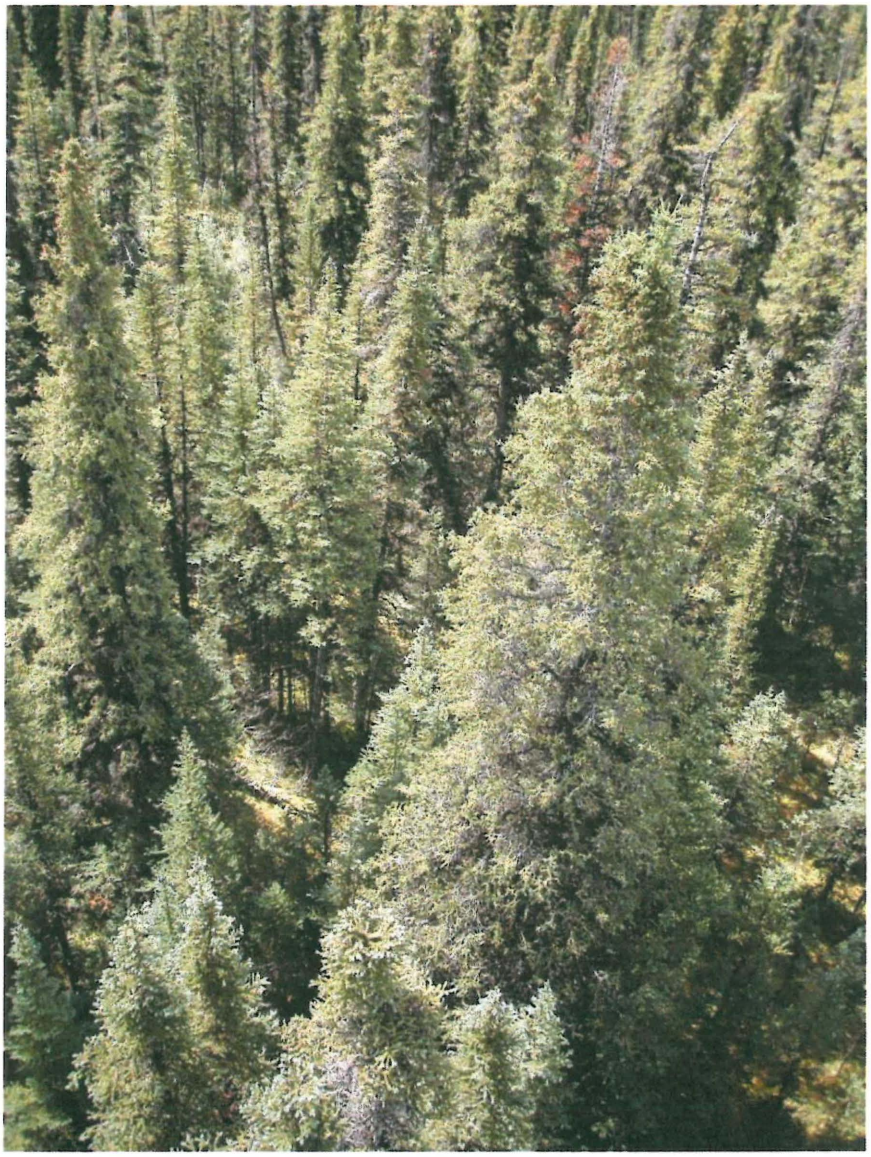

Photo 9. White Spruce/Feather moss association

Pine (Pl)

The Pine vegetation association is as its name suggests, a dominant tree canopy of lodgepole pine (*Pinus contorta*). It is found mostly on upland areas around the Grum and Vangorda pit at the SE end of the LSA in the boreal zone. The average tree canopy height is 16 m, with a few white spruce trees scattered throughout the subcanopy. A tall shrub layer of Sitka alder (*Alnus crispa ssp. Sinuate*) and Scouler's willow (*Salix scouleriana*) is common and followed by a lower shrub layer of Labrador tea, prickly rose (*Rosa acicularis*) and buffaloberry (*Shepherdia canadensis*). Ground cover consisting of bog bilberry, crowberry, bunchberry (*Cornus canadensis*), common bearberry and twinflower (*Linnaea borealis*) are noted at lower cover values. Feathermosses are also a common ground cover. This vegetation association is a typical mid-successional forest following fire.

Photo 10. Pine association

Mixed Coniferous-Deciduous (Mx)

This vegetation association establishes on well drained sites over a broad elevation range. It consists of a mixture of coniferous and deciduous trees including white spruce, trembling aspen, balsam poplar (*Populus balsamifera*), lodgepole pine. Depending on moisture and nutrients, subalpine fir and/or black spruce (*Picea mariana*) may also be present. This is often a young forest or "mid-seral community following fire" (Staniforth, 1998) whereby trees are in both the tree canopy and shrub layer. Additional shrubs include dwarf birch, willow species and Labrador tea. Bog bilberry, crowberry and mountain cranberry comprise the layer of low growing shrubs whereby stair step moss, green reindeer lichen and pelt lichens moderately cover the remainder of the ground.

Photo 11. Mixed Coniferous-Deciduous association

Deciduous (Dd)

The deciduous vegetation association often establishes on sites regenerating from a disturbance, whether it be fire or human development. Sites tend to be located on well-drained slopes and are rich in diversity. Most often located in the boreal zone, trembling aspen is the dominant tree species ranging in height from 2 to 8 m tall, followed by balsam poplar on moister sites. Tall shrubs include willow species, Sitka alder, shrubby cinquefoil, Labrador tea, dwarf birch, buffaloberry and prickly rose. White spruce may also be visible in the understory. Low growing shrubs include arctic bearberry, common bearberry, mountain cranberry and blueberry willow (*Salix myrtilifolia*). The herbaceous layer consists of bunchberry, bastard toad-flax (*Geocaulon lividum*), fireweed (*Epilobium angustiflolium*), northern grass-of –parnassus (*Parnassia palustris*) and twin flower.

Photo 12. Deciduous association

Graminoid (Gr)

The graminoid vegetation association is found in lowland areas on and around the project footprint in the boreal zone. It generally comprises an area re-established from seed mixtures of grasses and low growing forbs such as the freshwater reservoir located SE of the tailings pond along the access road. Grasses such as brome (*Bromus spp.*), reedgrass species (*Calamagrostis spp.*) and fescue species (*Festuca spp.*) dominate this vegetation association. Sedge species can occur as well as various forbs such as fireweed and wormwood (*Artemisia spp.*).

Photo 13. Graminoid association

Appendix C

Species Observed During Faro Vegetation Surveys

Species Observed During Faro Vegetation Surveys

Scientific Name	Common Name
Abies lasiocarpa	subalpine fir
Alnus crispa ssp. sinuata	sitka alder
Arctagrostis latifolia	polar grass
Arctostaphylos rubra	alpine bearberry
Arctostaphylos uva-ursi	common bearberry
Aster species	aster
Aulocomium palustre	tuffted moss
Barbilophozia species	leafy liverwort species
Betula glandulosa	dwarf birch
Bryoria species	bryoria species
Calamagrostis species	reedgrass species
Carex aquatilis	water sedge
Carex species	sedge species
Cassiope tetragona	four-angled mountain-heather
Cladina mitis	green reindeer lichen
Cladina rangiferina	grey reindeer lichen
Cladonia species	cladonia species
Cornus canadensis	bunchberry
Dryas species	mountain-avens species
Elymus innovatus	hairy wild rye
Empetrum nigrum	crowberry
Epilobium angustifolium	fireweed
Epilobium ciliatum	purple-leaved willow-herb
Equisetum arvense	common horsetail
Equisetum scirpoides	dwarf scouring rush
Equisetum species	horsetail species
Flavocetraria nivalis	flattened snow lichen
Geocaulon lividum	bastard toad-flax
Hedysarum alpinum	alpine sweet-vetch
Hylocomium splendens	step moss
Juniperus communis	mountain juniper
Ledum groenlandicum	Labrador-tea
Linnaea borealis	twinflower
Lupinus arcticus	arctic lupine
Mnium species	mnium species
Orthilia secunda	one-sided wintergreen
Parnassia palustris	northern grass-of-parnassus
Peltigera aphthosa	freckled pelt
Peltigera species	pelt lichens
Petasites frigidus	sweet coltsfoot
Picea glauca	white spruce
Picea mariana	black spruce
Pinus contorta	lodgepole pine
Pleurozium shreberi	red-stemmed feathermoss
Poa species	bluegrass species
Polytrichum species	haircap moss

Populus balsamifera	balsam poplar
Populus tremuloides	trembling aspen
Potentilla fruticosa	shrubby cinquefoil
Rosa acicularis	prickly rose
Salix athabascensis	Athabasca willow
Salix myrtillifolia	blueberry willow
Salix planifolia	tea-leaved willow
Salix reticulata	net-veined willow
Salix scouleriana	Scouler's willow
Salix species	willow species
Senecio lugens	black-tipped groudsel
Shepherdia canadensis	buffaloberry
Sphagnum species	sphagnum species
Stereocaulon paschale	cottontail coral
Vaccinium uliginosum	bog bilberry
Vaccinium vitis-idea	mountain cranberry

Appendix D

Vascular Plant Species Ranked in the Yukon Territory by the General Status of Species in Canada

Vascular Plant Species in the Yukon Territory ranked by the General Status of Species in Canada (Wild Species, 2005).

Scientific Name	Common Name	Yukon Territory Rank
Achnatherum nelsonii	Columbia Needle Grass	Sensitive
Achnatherum richardsonii	Richardson's Needle Grass	Sensitive
Actaea rubra	Red Baneberry	Sensitive
Agrostis exarata	Spiked Bent Grass	Sensitive
Agrostis humilis	Alpine Bent Grass	May be at Risk
Agrostis mertensii	Northern Bent Grass	Sensitive
Alisma triviale	Northern Water Plantain	May be at Risk
Alopecurus borealis	Alpine Foxtail	Sensitive
Alyssum obovatum	American Madwort	Sensitive
Anaphalis margaritacea	Pearly Everlasting	May be at Risk
Anemone multiceps	Purple Anemone	May be at Risk
Angelica lucida	Seaside Angelica	May be at Risk
Antennaria densifolia	Dense-leaved Pussytoes	Sensitive
Antennaria howellii	Howell's Pussytoes	May be at Risk
Antennaria media	Rocky Mountain Pussytoes	May be at Risk
Antennaria microphylla	Small-leaved Pussytoes	Sensitive
Aphragmus eschscholtzianus	Aleutian Cress	May be at Risk
Apocynum androsaemifolium	Spreading Dogbane	Sensitive
Aquilegia formosa	Sitka Columbine	Sensitive
Arabidopsis salsuginea	Saltwater Cress	May be at Risk
Arabis arenicola	Arctic Rockcress	May be at Risk
Arabis boivinii	Boivin's Rockcress	May be at Risk
Arabis calderi	Calder's Rockcress	Sensitive
Arabis codyi	Cody's Rockcress	May be at Risk
Arabis glabra	Tower Mustard	May be at Risk
Arabis lemmonii	Lemmon's Rockcress	May be at Risk
Arabis lignifera	Owens Valley Rockcress	May be at Risk
Arabis media	Sand-dune Rockcress	May be at Risk
Arabis murrayi	Murray's Rockcress	May be at Risk
Arabis nuttallii	Nuttall's Rockcress	May be at Risk
Arabis sparsiflora	Elegant Rockcress	May be at Risk
Aralia nudicaulis	Wild Sarsaparilla	Sensitive
Arenaria longipedunculata	Long-stemmed Sandwort	May be at Risk
Argentina egedii	Egede Cinquefoil	May be at Risk
Armeria maritima	Labrador Sea Thrift	May be at Risk
Arnica amplexicaulis	Streambank Arnica	May be at Risk
Arnica chamissonis	Leafy Arnica	Sensitive
Arnica mollis	Hairy Arnica	May be at Risk
Arnica parryi	Nodding Arnica	May be at Risk
Artemisia dracunculus	Dragon Wormwood	May be at Risk
Artemisia furcata	Three-forked Wormwood	Sensitive
Artemisia globularia	Boreal Wormwood	May be at Risk
Artemisia glomerata	Wormwood	May be at Risk
Artemisia laciniata	Siberian Wormwood	May be at Risk
Artemisia michauxiana	Michaux's Wormwood	May be at Risk
Artemisia rupestris	Rock Wormwood	May be at Risk

Aruncus dioicus	Common Goats-beard	May be at Risk
Asplenium trichomanes-ramosum	Green Spleenwort	May be at Risk
Astragalus agrestis	Meadow Milk-vetch	Sensitive
Astragalus nutzotinensis	Nutzotin's Milk-vetch	Sensitive
Astragalus robbinsii	Robbins' Milk-vetch	May be at Risk
Astragalus tenellus	Loose-flowered Milk-vetch	Sensitive
Astragalus williamsii	Williams' Milk-vetch	Sensitive
Athyrium alpestre	Alpine Lady Fern	May be at Risk
Athyrium filix-femina	Lady Fern	Sensitive
Atriplex dioica	Thick-leaved Orache	May be at Risk
Avenula hookeri	Hooker's Oats	May be at Risk
Betula pumila	Bog Birch	Sensitive
Bidens cernua	Nodding Beggarticks	May be at Risk
Blysmopsis rufa	Red Bulrush	May be at Risk
Botrychium hesperium	Western Moonwort	May be at Risk
Botrychium lanceolatum	Triangle Moonwort	Sensitive
Botrychium lineare	Narrow-leaved Moonwort	May be at Risk
Botrychium multifidum	Leathery Moonwort	May be at Risk
Botrychium pinnatum	Northwestern Moonwort	Sensitive
Botrychium spathulatum	Spatulate Moonwort	May be at Risk
Botrychium tunux	Tunux Moonwort	May be at Risk
Botrychium virginianum	Rattlesnake Fern	Sensitive
Botrychium yaaxudakeit	Yaa Xu da Keit Moonwort	May be at Risk
Braya glabella	Purple Rockcress	Sensitive
Bromus richardsonii	Richardson's Brome	May be at Risk
Calamagrostis deschampsioides	Circumpolar Reed Grass	May be at Risk
Caltha leptosepala	White Marsh Marigold	May be at Risk
Caltha natans	Floating Marsh Marigold	May be at Risk
Caltha palustris	Marsh Marigold	Sensitive
Calypso bulbosa	Calypso	Sensitive
Campanula rotundifolia	Harebell	May be at Risk
Canadanthus modestus	Great Northern Aster	May be at Risk
Cardamine microphylla	Small-leaved Bittercress	Sensitive
Cardamine pensylvanica	Pennsylvania Bittercress	Sensitive
Carex albonigra	Black-and-white Scale Sedge	Sensitive
Carex anthoxanthea	Yellow-flowered Sedge	May be at Risk
Carex arcta	Northern Clustered Sedge	May be at Risk
Carex athrostachya	Slender-beaked Sedge	May be at Risk
Carex bebbii	Bebb's Sedge	May be at Risk
Carex bicolor	Two-coloured Sedge	May be at Risk
Carex bonanzensis	Yukon Sedge	Sensitive
Carex buxbaumii	Buxbaum's Sedge	Sensitive
Carex crawfordii	Crawford's Sedge	Sensitive
Carex deweyana	Dewey's Sedge	Sensitive
Carex eburnea	Bristle-leaved Sedge	Sensitive
Carex eleusinoides	Goosegrass Sedge	Sensitive
Carex flava	Yellow Sedge	May be at Risk
Carex glareosa	Gravel Sedge	Sensitive
Carex heleonastes	Hudson Bay Sedge	May be at Risk
Carex holostoma	Arctic Marsh Sedge	May be at Risk
Carex incurviformis	Curved-spiked Sedge	Sensitive

Carex interior	Inland Sedge	May be at Risk
Carex krausei	Krause's Sedge	Sensitive
Carex lapponica	Lapland Sedge	May be at Risk
Carex lasiocarpa	Slender Sedge	Sensitive
Carex laxa	Weak Sedge	May be at Risk
Carex livida	Livid Sedge	Sensitive
Carex macrochaeta	Large-awned Sedge	Sensitive
Carex marina	Sea Sedge	May be at Risk
Carex maritima	Seaside Sedge	Sensitive
Carex microptera	Small-winged Sedge	Sensitive
Carex nigricans	Black Alpine Sedge	May be at Risk
Carex norvegica	Norway Sedge	May be at Risk
Carex oligosperma	Few-seeded Sedge	May be at Risk
Carex parryana	Parry's Sedge	Sensitive
Carex pauciflora	Few-flowered Sedge	May be at Risk
Carex peckii	Peck's Sedge	May be at Risk
Carex phaeocephala	Dunhead Sedge	Sensitive
Carex praegracilis	Clustered Field Sedge	Sensitive
Carex prairea	Prairie Sedge	May be at Risk
Carex rostrata	Beaked Sedge	Sensitive
Carex sabulosa	Baikal Sedge	May be at Risk
Carex sartwellii	Sartwell's Sedge	May be at Risk
Carex spectabilis	Showy Sedge	May be at Risk
Carex stylosa	Variegated Sedge	May be at Risk
Carex subspathacea	Hoppner's Sedge	Sensitive
Carex sychnocephala	Dense Long-beaked Sedge	Sensitive
Carex ursina	Bear Sedge	Sensitive
Carex viridula	Greenish Sedge	Sensitive
Carex williamsii	Williams' Sedge	Sensitive
Carex xerantica	Dryland Sedge	May be at Risk
Cassiope mertensiana	Western Bell Heather	May be at Risk
Castilleja elegans	Elegant Indian Paintbrush	Sensitive
Castilleja miniata	Greater Red Indian Paintbrush	May be at Risk
Castilleja parviflora	Small-flowered Indian Paintbrush	May be at Risk
Cerastium maximum	Great Chickweed	Sensitive
Ceratophyllum demersum	Common Coontail	Sensitive
Chamaerhodos erecta	Rose Chamaehodos	Sensitive
Chenopodium glaucum	Oak-leaved Goosefoot	May be at Risk
Chenopodium leptophyllum	Slim-leaved Goosefoot	May be at Risk
Chenopodium rubrum	Red Pigweed	Sensitive
Chenopodium simplex	Maple-leaved Goosefoot	May be at Risk
Chimaphila umbellata	Pipsissewa	May be at Risk
Chrysosplenium wrightii	Wright's Golden Saxifrage	Sensitive
Cicuta bulbifera	Bulbous Water-hemlock	May be at Risk
Cicuta maculata	Spotted Water-hemlock	Sensitive
Cicuta virosa	Mackenzie's Water-hemlock	Sensitive
Cinna latifolia	Drooping Wood Reed Grass	Sensitive
Circaea alpina	Small Enchanter's Nightshade	May be at Risk
Cirsium foliosum	Leafy Thistle	May be at Risk
Claytonia megarhiza	Alpine Spring Beauty	May be at Risk
Claytonia ogilviensis	Ogilvie Spring Beauty	May be at Risk

Claytonia scammaniana	Scamman's Spring Beauty	Sensitive
Coeloglossum viride	Long-bracted Orchid	May be at Risk
Collinsia parviflora	Small-flowered Blue-eyed Mary	May be at Risk
Collomia linearis	Narrow-leaved Collomia	Sensitive
Comandra umbellata	Bastard's Toadflax	May be at Risk
Corispermum ochotense	Alaskan Bugseed	May be at Risk
Cornus unalaschkensis	Cordilleran Bunchberry	Sensitive
Crassula aquatica	Water Pygmyweed	May be at Risk
Cryptogramma acrostichoides	American Parsley Fern	Sensitive
Cryptogramma sitchensis	Alaska Parsley Fern	May be at Risk
Cryptogramma stelleri	Slender Rock-brake	May be at Risk
Cynoglossum virginianum	Wild Comfrey	May be at Risk
Cypripedium guttatum	Spotted Lady's-slipper	May be at Risk
Cypripedium parviflorum	Yellow Lady's-slipper	May be at Risk
Danthonia spicata	Poverty Oat Grass	May be at Risk
Delphinium brachycentrum	Arctic Larkspur	May be at Risk
Dendranthema arcticum	Arctic Daisy	May be at Risk
Descurainia pinnata	Green Tansy Mustard	May be at Risk
Dianthus repens	Northern Pink	May be at Risk
Diapensia lapponica	Diapensia	Sensitive
Diphasiastrum sitchense	Sitka Clubmoss	May be at Risk
Dodecatheon pulchellum	Few-flowered Shooting Star	May be at Risk
Douglasia alaskana	Alaska Dwarf Primrose	May be at Risk
Douglasia arctica	Mackenzie River Dwarf Primrose	Sensitive
Draba albertina	Slender Whitlow-grass	Sensitive
Draba corymbosa	Flat-topped Whitlow-grass	Sensitive
Draba kluanei	Kluane Whitlow-grass	May be at Risk
Draba lactea	Milky Whitlow-grass	Sensitive
Draba lonchocarpa	Lance-podded Whitlow-grass	Sensitive
Draba macounii	Macoun's Whitlow-grass	Sensitive
Draba murrayi	Murray's Whitlow-grass	May be at Risk
Draba nemorosa	Woodland Whitlow-grass	Sensitive
Draba ogilviensis	Ogilvie Range Whitlow-grass	Sensitive
Draba oligosperma	Few-seeded Whitlow-grass	Sensitive
Draba porsildii	Porsild's Whitlow-grass	May be at Risk
Draba ruaxes	Rainier Whitlow-grass	May be at Risk
Draba scotteri	Scotter's Whitlow-grass	May be at Risk
Draba stenoloba	Alaska Whitlow-grass	Sensitive
Draba stenopetala	Anadyr Whitlow-grass	May be at Risk
Draba ventosa	Wind River Whitlow-grass	May be at Risk
Draba yukonensis	Yukon Whitlow-grass	May be at Risk
Drosera anglica	English Sundew	Sensitive
Dryopteris carthusiana	Spinulose Wood Fern	May be at Risk
Dryopteris expansa	Northern Wood Fern	Sensitive
Dupontia fisheri	Fisher's Tundra Grass	Sensitive
Elatine triandra	Long-stemmed Waterwort	May be at Risk
Eleocharis uniglumis	Single-glumed Spike-rush	May be at Risk
Elymus glaucus	Blue Wild Rye	Sensitive
Elymus hyperarcticus	Tundra Wild Rye	Sensitive
Epilobium arcticum	Arctic Willowherb	May be at Risk
Epilobium clavatum	Talus Willowherb	May be at Risk

Epilobium davuricum	Dahurian Willowherb	May be at Risk
Epilobium lactiflorum	White-flowered Willowherb	Sensitive
Eremogone capillaris	Slender Mountain Sandwort	Sensitive
Erigeron grandiflorus	Large-flowered Fleabane	Sensitive
Erigeron hyperboreus	Tundra Fleabane	May be at Risk
Erigeron hyssopifolius	Hyssop-leaved Fleabane	Sensitive
Erigeron muirii	Muir's Fleabane	May be at Risk
Erigeron ochroleucus	Buff Fleabane	May be at Risk
Erigeron peregrinus	Foreign Fleabance	May be at Risk
Erigeron philadelphicus	Philadelphia Fleabane	May be at Risk
Erigeron purpuratus	Fleabane	Sensitive
Erigeron uniflorus	One-flowered Fleabane	Sensitive
Erigeron yukonensis	Yukon Fleabane	May be at Risk
Eriogonum flavum	Yellow Buckwheat	May be at Risk
Eriophorum gracile	Slender Cottongrass	May be at Risk
Eriophorum viridicarinatum	Green-keeled Cottongrass	May be at Risk
Eritrichium splendens	Showy Forget-me-not	May be at Risk
Erysimum angustatum	Narrow-leaved Wallflower	May be at Risk
Festuca brevissima	Alaska Fescue	Sensitive
Festuca hyperborea	Northern Fescue	May be at Risk
Festuca lenensis	Tundra Fescue	Sensitive
Festuca minutiflora	Small-flowered Fescue	May be at Risk
Fritillaria camschatcensis	Kamchatka Fritillary	May be at Risk
Galium triflorum	Fragrant Bedstraw	Sensitive
Gentianella tenella	Dane's Gentian	May be at Risk
Gentianopsis detonsa	Sheared Gentian	Sensitive
Geranium bicknellii	Bicknell's Geranium	Sensitive
Geranium erianthum	Northern Crane's-bill	Sensitive
Geranium richardsonii	Richardson Geranium	Sensitive
Geum aleppicum	Yellow Avens	Sensitive
Geum triflorum	Prairie-smoke	May be at Risk
Glaux maritima	Sea Milkwort	May be at Risk
Glyceria borealis	Northern Manna Grass	Sensitive
Glyceria grandis	Common Tall Manna Grass	Sensitive
Glyceria pulchella	Graceful Manna Grass	Sensitive
Glyceria striata	Fowl Manna Grass	Sensitive
Gymnocarpium jessoense	Nahanni Oak Fern	Sensitive
Halimolobos mollis	Soft Fissurewort	Sensitive
Harrimanella stelleriana	Starry Bell Heather	May be at Risk
Hieracium albiflorum	White-flowered Hawkweed	May be at Risk
Hieracium umbellatum	Umbellate Hawkweed	Sensitive
Hierochloë pauciflora	Arctic Sweet Grass	May be at Risk
Hippuris montana	Mountain Marestail	May be at Risk
Hippuris tetraphylla	Four-leaved Marestail	Sensitive
Hordeum brachyantherum	Meadow Barley	Sensitive
Iris setosa	Beach-head Iris	May be at Risk
Isoëtes echinospora	Spiny-spored Quillwort	May be at Risk
Isoëtes maritima	Maritime Quillwort	May be at Risk
Juncus nodosus	Knotted Rush	Sensitive
Juncus stygius	Moor Rush	May be at Risk
Koeleria asiatica	Oriental June Grass	Sensitive

Koeleria macrantha	Prairie June Grass	Sensitive
Koenigia islandica	Iceland Purslane	Sensitive
Krascheninnikovia lanata	Winterfat	May be at Risk
Lactuca biennis	Tall Blue Lettuce	May be at Risk
Lathyrus japonicus	Beach Pea	May be at Risk
Lathyrus ochroleucus	Cream Vetchling	Sensitive
Leptarrhena pyrolifolia	Leather-leaved Saxifrage	Sensitive
Lesquerella arctica	Arctic Bladderpod	Sensitive
Lesquerella calderi	Calder's Bladderpod	Sensitive
Lewisia pygmaea	Alpine Lewisia	May be at Risk
Leymus mollis	Sea Lyme Grass	Sensitive
Limosella aquatica	Northern Mudwort	Sensitive
Lonicera dioica	Mountain Honeysuckle	May be at Risk
Luetkea pectinata	Segmented Luetke	Sensitive
Lupinus kuschei	Yukon Lupine	Sensitive
Lupinus nootkatensis	Nootka Lupine	May be at Risk
Luzula groenlandica	Greenland Woodrush	May be at Risk
Luzula piperi	Piper's Woodrush	Sensitive
Luzula wahlenbergii	Wahlenberg's Woodrush	Sensitive
Lycopodium dendroideum	Prickly Tree Clubmoss	May be at Risk
Lysimachia thyrsiflora	Tufted Yellow Loosestrife	May be at Risk
Maianthemum canadense	Wild Lily-of-the-valley	Sensitive
Maianthemum trifolium	Three-leaved False Soloman's Seal	Sensitive
Malaxis paludosa	Bog Adder's-mouth	May be at Risk
Matteuccia struthiopteris	Ostrich Fern	May be at Risk
Mentha arvensis	Wild Mint	Sensitive
Mertensia maritima	Sea Lungwort	May be at Risk
Mimulus guttatus	Common Large Monkey Flower	Sensitive
Minuartia macrocarpa	Long-Pod Stitchwort	Sensitive
Minuartia rossii	Ross' Stitchwort	May be at Risk
Minuartia stricta	Bog Stitchwort	Sensitive
Minuartia yukonensis	Yukon Stitchwort	Sensitive
Mitella pentandra	Five-Stamen Bishop's-cap	May be at Risk
Monolepis nuttalliana	Nuttall's Povertyweed	Sensitive
Montia bostockii	Bostock's Montia	Sensitive
Montia fontana	Water Blinks	May be at Risk
Muhlenbergia glomerata	Spiked Muhly	May be at Risk
Muhlenbergia mexicana	Mexican Muhly	May be at Risk
Muhlenbergia richardsonis	Mat Muhly	Sensitive
Myriophyllum verticillatum	Whorled Water Milfoil	Sensitive
Najas flexilis	Slender Naiad	May be at Risk
Nuphar variegata	Variegated Pond-lily	Sensitive
Oplopanax horridus	Devil's Club	May be at Risk
Orobanche fasciculata	Clustered Broomrape	Sensitive
Orthocarpus luteus	Yellow Owl-clover	May be at Risk
Oryzopsis asperifolia	White-grained Mountain Rice	Sensitive
Osmorhiza depauperata	Blunt Sweet Cicely	Sensitive
Oxytropis arctica	Arctic Locoweed	May be at Risk
Oxytropis huddelsonii	Huddelson's Locoweed	Sensitive
Oxytropis mertensiana	Mertens' Locoweed	May be at Risk
Oxytropis sericea	Silky Locoweed	May be at Risk

Packera hyperborealis	Boreal Groundsel	Sensitive
Papaver alboroseum	Pale Poppy	May be at Risk
Papaver gorodkovii	Russian Poppy	May be at Risk
Papaver mcconnellii	McConnell's Poppy	Sensitive
Papaver nudicaule	Iceland Poppy	Sensitive
Papaver walpolei	Walpole's Poppy	May be at Risk
Parietaria pensylvanica	Pennsylvania Pellitory	May be at Risk
Pedicularis groenlandica	Greenland Lousewort	May be at Risk
Pedicularis lapponica	Lapland Lousewort	Sensitive
Pedicularis macrodonta	Muskeg Lousewort	May be at Risk
Persicaria lapathifolia	Pale Smartweed	May be at Risk
Persicaria pensylvanica	Pennsylvania Smartweed	May be at Risk
Phacelia mollis	Coffee Creek Scorpionweed	Sensitive
Phalaris arundinacea	Reed Canary Grass	Sensitive
Phegopteris connectilis	Northern Beech Fern	May be at Risk
Phippsia algida	Ice Grass	Sensitive
Phyllodoce glanduliflora	Yellow Mountain Heather	Sensitive
Pinguicula macroceras	California Butterwort	May be at Risk
Piptatherum pungens	Slender Rice Grass	May be at Risk
Plantago eriopoda	Red Woolly Plantain	Sensitive
Plantago major	Common Plantain	Sensitive
Plantago maritima	Seaside Plantain	May be at Risk
Platanthera dilatata	White Bog Orchid	Sensitive
Platanthera orbiculata	Small Round-leaved Orchid	Sensitive
Platanthera stricta	Slender Bog Orchid	May be at Risk
Poa abbreviata	Northern Blue Grass	May be at Risk
Poa cusickii	Cusick's Blue Grass	May be at Risk
Poa interior	Inland Blue Grass	Sensitive
Poa porsildii	Porsild's Blue Grass	Sensitive
Poa pseudoabbreviata	Polar Blue Grass	May be at Risk
Poa secunda	Curly Blue Grass	Sensitive
Podistera macounii	Macoun's Podistera	May be at Risk
Podistera yukonensis	Yukon Podistera	May be at Risk
Polygonum douglasii	Douglas' Knotweed	May be at Risk
Polygonum humifusum	Alaska Knotweed	Sensitive
Polypodium sibiricum	Siberian Polypody	May be at Risk
Polystichum kruckebergii	Kruckeberg's Sword Fern	May be at Risk
Polystichum lonchitis	Northern Holly Fern	May be at Risk
Potamogeton foliosus	Leafy Pondweed	May be at Risk
Potamogeton obtusifolius	Blunt-leaved Pondweed	May be at Risk
Potamogeton praelongus	White-stemmed Pondweed	Sensitive
Potamogeton strictifolius	Straight-leaved Pondweed	May be at Risk
Potamogeton subsibiricus	Yenissei River Pondweed	May be at Risk
Potamogeton zosteriformis	Flat-stemmed Pondweed	Sensitive
Potentilla bimundorum	Staghorn Cinquefoil	Sensitive
Potentilla bipinnatifida	Tansy Cinquefoil	May be at Risk
Potentilla elegans	Elegant Cinquefoil	Sensitive
Potentilla nivea	Snowy Cinquefoil	Sensitive
Potentilla ovina	Sheep Cinquefoil	May be at Risk
Potentilla pulchella	Pretty Cinquefoil	May be at Risk
Potentilla rubricaulis	Rocky Mountain Cinquefoil	Sensitive

Primula borealis	Slender Primrose	Sensitive
Primula egaliksensis	Greenland Primrose	Sensitive
Primula eximia	Arctic Primrose	Sensitive
Primula incana	Mealy Primrose	Sensitive
Primula mistassinica	Lake Mistassini Primrose	Sensitive
Primula nutans	Arctic Primrose	Sensitive
Prunella vulgaris	Common Heal-all	May be at Risk
Puccinellia distans	Spreading Alkali Grass	May be at Risk
Puccinellia nutkaensis	Nootka Alkali Grass	Sensitive
Puccinellia nuttalliana	Nuttall's Alkali Grass	Sensitive
Puccinellia phryganodes	Creeping Alkali Grass	Sensitive
Puccinellia vaginata	Tussock Alkali Grass	Sensitive
Puccinellia vahliana	Vahl's Alkali Grass	May be at Risk
Ranunculus abortivus	Kidney-leaved Buttercup	Sensitive
Ranunculus cymbalaria	Seaside Buttercup	Sensitive
Ranunculus gelidus	Arctic Buttercup	May be at Risk
Ranunculus occidentalis	Western Buttercup	Sensitive
Ranunculus pallasii	Pallas' Buttercup	Sensitive
Ranunculus pedatifidus	Northern Buttercup	Sensitive
Ranunculus turneri	Turner's Buttercup	Sensitive
Ribes laxiflorum	Trailing Black Currant	May be at Risk
Rorippa barbareifolia	Hoary Yellowcress	Sensitive
Rosa woodsii	Wood's Rose	May be at Risk
Rubus pedatus	Five-leaved Dwarf Bramble	May be at Risk
Rubus pubescens	Dwarf Red Raspberry	Sensitive
Rumex beringensis	Bering Sea Dock	May be at Risk
Rumex fueginus	Tierra del Fuego Dock	Sensitive
Rumex lapponicus	Lapland Sorrel	May be at Risk
Rumex sibiricus	Siberian Dock	Sensitive
Ruppia cirrhosa	Spiral Ditchgrass	May be at Risk
Sagina nivalis	Snow Pearlwort	Sensitive
Sagina saginoides	Alpine Pearlwort	Sensitive
Sagittaria cuneata	Northern Arrowhead	Sensitive
Salicornia rubra	Red Glasswort	May be at Risk
Salix arctophila	Northern Willow	May be at Risk
Salix athabascensis	Athabasca Willow	Sensitive
Salix brachycarpa	Short-capsuled Willow	Sensitive
Salix candida	Hoary Willow	Sensitive
Salix chamissonis	Chamisso's Willow	Sensitive
Salix commutata	Under-green Willow	Sensitive
Salix drummondiana	Drummond's Willow	Sensitive
Salix farriae	Farr's Willow	Sensitive
Salix maccalliana	Mccalla's Willow	May be at Risk
Salix ovalifolia	Oval-leaved Willow	Sensitive
Salix pedicellaris	Bog Willow	May be at Risk
Salix prolixa	Mackenzie's Willow	May be at Risk
Salix pyrifolia	Balsam Willow	May be at Risk
Salix raupii	Raup's Willow	May be at Risk
Salix rotundifolia	Round-leaved Willow	Sensitive
Salix setchelliana	Setchell's Willow	Sensitive
Sambucus racemosa	Red Elderberry	May be at Risk

Sanguisorba officinalis	Great Burnet	Sensitive
Saussurea americana	American Saw-wort	May be at Risk
Saussurea viscida	Sticky Saw-wort	May be at Risk
Saxifraga eschscholtzii	Cushion Saxifrage	May be at Risk
Saxifraga foliolosa	Leafy Saxifrage	Sensitive
Saxifraga nivalis	Snow Saxifrage	Sensitive
Saxifraga spicata	Spiked Saxifrage	May be at Risk
Scheuchzeria palustris	Marsh Scheuchzeria	Sensitive
Schizachne purpurascens	Purple Oat Grass	Sensitive
Schoenoplectus acutus	Hard-stemmed Bulrush	Sensitive
Schoenoplectus tabernaemontani	Soft-stemmed Bulrush	Sensitive
Scirpus microcarpus	Small-fruited Bulrush	Sensitive
Scolochloa festucacea	Common River Grass	May be at Risk
Scutellaria galericulata	Hooded Skullcap	Sensitive
Senecio sheldonensis	Mount Sheldon Ragwort	May be at Risk
Silene williamsii	William's Catchfly	May be at Risk
Sisyrinchium montanum	Mountain Blue-eyed-grass	Sensitive
Sium suave	Water Parsnip	May be at Risk
Smelowskia borealis	Boreal Smelowskia	Sensitive
Smelowskia calycina	Alpine Smelowskia	Sensitive
Sorbus scopulina	Greene Mountain Ash	Sensitive
Sorbus sitchensis	Sitka Mountain Ash	May be at Risk
Sparganium natans	Small Burreed	Sensitive
Sphenopholis intermedia	Slender Wedge Grass	May be at Risk
Stellaria alaskana	Alaska Starwort	May be at Risk
Stellaria calycantha	Northern Bog Starwort	Sensitive
Stellaria dicranoides	Matted Starwort	May be at Risk
Stellaria umbellata	Umbrella Starwort	May be at Risk
Stenotus macleanii	Maclean's Goldenweed	May be at Risk
Streptopus amplexifolius	Clasping-leaved Twisted-stalk	Sensitive
Suaeda calceoliformis	Horned Sea-blite	May be at Risk
Subularia aquatica	Water Awlwort	Sensitive
swertia perennis	Felwort	May be at Risk
Symphyotrichum boreale	Boreal Aster	May be at Risk
Symphyotrichum ciliatum	Alkali Aster	May be at Risk
Symphyotrichum ciliolatum	Ciliolate Aster	Sensitive
Symphyotrichum laeve	Smooth Blue Aster	May be at Risk
Symphyotrichum yukonense	Yukon Aster	May be at Risk
Synthyris borealis	Alaska Kitten's Tail	Sensitive
Tanacetum bipinnatum	Floccose Tansy	Sensitive
Taraxacum carneocoloratum	Pink Dandelion	May be at Risk
Tephroseris kjellmanii	Kjellman's Groundsel	Sensitive
Thalictrum occidentale	Western Meadow-rue	Sensitive
Thlaspi arcticum	Arctic Pennycress	May be at Risk
Torreyochloa pallida	Pale False Manna Grass	May be at Risk
Townsendia hookeri	Hooker's Townsend Daisy	Sensitive
Toxicodendron rydbergii	Northern Poison Oak	May be at Risk
Triantha glutinosa	Sticky False Asphodel	Sensitive
Trichophorum alpinum	Alpine Cottongrass	Sensitive
Trichophorum pumilum	Dwarf Clubrush	Sensitive
Trientalis borealis	Northern Starflower	May be at Risk

Tripleurospermum maritima	Seashore Chamomile	May be at Risk
Trisetum sibiricum	Siberian False Oats	May be at Risk
Typha latifolia	Broad-leaved Cattail	Sensitive
Utricularia minor	Lesser Bladderwort	Sensitive
Vaccinium caespitosum	Dwarf Bilberry	Sensitive
Vaccinium membranaceum	Mountain Huckleberry	May be at Risk
Vaccinium ovalifolium	Oval-leaved Bilberry	Sensitive
Vahlodea atropurpurea	Mountain Hair Grass	Sensitive
Veronica peregrina	Purslane Speedwell	May be at Risk
Veronica scutellata	Marsh Speedwell	Sensitive
Vicia americana	Purple Vetch	Sensitive
Viola adunca	Sand Violet	Sensitive
Viola biflora	Northern Violet	May be at Risk
Viola canadensis	Canada Violet	Sensitive
Viola langsdorfii	Aleutian Violet	Sensitive
Viola nephrophylla	Northern Bog Violet	May be at Risk
Viola selkirkii	Great-spurred Violet	May be at Risk
Woodsia alpina	Alpine Woodsia	Sensitive
Woodsia ilvensis	Rusty Woodsia	May be at Risk
Woodsia scopulina	Mountain Woodsia	May be at Risk
Zannichellia palustris	Horned Pondweed	May be at Risk
Zizia aptera	Heart-leaved Alexanders	May be at Risk

Appendix E

Rare Vascular Plant Species Tracked by the Yukon Government

Rare and Threatened Vascular Plant Species Tracked by the Yukon Government

Scientific Name	Common Name	S Rank	New S Rank	NOTES
Aconitum delphiniifolium ssp. paradoxum		S3		
Actaea rubra ssp. arguta	Red Baneberry	S2S3		
Agrostis clavata	Clubbed Bent	S1		
Agrostis exarata	Spike Redtop	S2S3		
Agrostis humilis	Alpine Bent Grass	S1		
Agrostis mertensii	Red Bent Grass	S2S3		
Alisma triviale	Water-plantain	S1		
Alnus crispa ssp. sinuata	Sitka Alder	S2	S2S3	
Alyssum obovatum	American Alyssum	S2S3		
Anaphalis margaritacea	Pearly Everlasting	S1		
Anemone multiceps	Porcupine River Thimble-weed	S1	S2	more common than previously thought
Angelica lucida	Angelica	S2		
Antennaria friesiana ssp. alaskana		S3		
Antennaria howellii	Howell's Pussytoes	S2		
Antennaria howellii ssp. canadensis		S1		
Antennaria howellii ssp. howellii	Howell's Pussytoes	S1		
Antennaria media		S2		
Antennaria microphylla	Small-leaf Cat's-foot	S2		
Aphragmus eschscholtzianus		S1	S2S3	more common than previously thought; all populations are within protected areas
Aquilegia formosa	Crimson Columbine	S2		
Aquilegia formosa var. formosa		S2		
Arabis boivinii	Boivin's Rockcress	S1		
Arabis calderi	Calder's Rockcress	S3		
Arabis codyi	Cody's Rockcress	S1		
Arabis columbiana	Elegant Rockcress	S1		
Arabis drepanoloba	Soldier Rockcress	S1		
Arabis eschscholtziana	Eschscholtz's Rockcress	S1S2		
Arabis glabra	Tower Mustard	S1		
Arabis glabra var.	Tower Mustard	S1		

glabra				
Arabis lemmonii	Lemmon'sRockcress	S1		
Arabis lemmonii var. lemmonii	Lemmon's Rockcress	S1		
Arabis lignifera	Woody-branched Rockcress	S1		
Arabis media	Sund-dune Rockcress	S2	SH	not relocated in recent surveys
Arabis murrayi		S1		
Arabis nuttallii	Nuttall Rock-cress	S2		
Arabis pinetorum		S2		
Arabis sparsiflora	Elegant Rock-cress	S1		
Aralia nudicaulis	Wild Sarsaparilla	S2S3		
Arenaria capillaris	Fescue Sandwort	S3	S3S4	Locally common occurring in large widespread populations
Arenaria capillaris ssp. capillaris		S3	S3S4	Locally common occurring in large widespread populations
Arenaria longipedunculata	Low Sandwort	S2		
Armeria maritima	Western Thrift	S2	S1S2	several populations along the coast not relocated
Armeria maritima ssp. arctica		S2	S1S2	several populations along the coast not relocated
Arnica angustifolia ssp. tomentosa	Alpine Arnica	S1		
Arnica chamissonis	Leafy Arnica	S3		
Arnica chamissonis ssp. chamissonis		S3		
Arnica chamissonis ssp. foliosa	Leafy Leopardbane	S2		
Arnica chamissonis ssp. incana		S2		
Arnica mollis	Hairy Arnica	S2		
Arnica parryi	Nodding Arnica	S1		
Artemisia arctica ssp. comata		S1	S3	Locally common and the majority of populations occur in Ivvavik National Park
Artemisia dracunculus	Dragonwort	S2	S2S3	more widespread than previously thought, local populations larger than previously

				thought, several in protected areas
Artemisia globularia	Arctic Wormwood	S2	S2S3	most sites remote with few threats, most are within Ivvavik National Park
Artemisia glomerata	Pacific Alpine Wormwood	S2	S2S3	most sites remote with few threats, most are within Ivvavik National Park
Artemisia laciniata	Siberian Wormwood	S1		
Artemisia michauxiana	Michaux Wormwood	S1		
Artemisia rupestris	Rock Wormwood	S2		
Artemisia rupestris ssp. woodii		S2		
Aruncus dioicus	Common Goatsbeard	S1		
Aruncus dioicus var. acuminatus		S1		
Asplenium trichomanes-ramosum	Green Spleenwort	S1		
Aster borealis	Boreal Aster	S2S3		
Aster brachyactis	Alkali Rayless Aster	S1		
Aster ciliolatus	Fringed Aster	S2S3		
Aster laevis	Smooth Aster	S1		
Aster laevis ssp. geyeri	Smooth Aster	S1		
Aster modestus	Western Bog Aster	S3		
Aster yukonensis	Yukon Aster	S1S2	S2	locally common and some populations protected, two known sites destroyed by highway construction at Kluane Lake and Donjek River
Astragalus adsurgens ssp. robustior		S1S2		
Astragalus agrestis	Purple Milk-vetch	S2S3		
Astragalus nutzotinensis	Nutzotin Milk-vetch	S3		
Astragalus robbinsii	Robbins Milkvetch	S1		
Astragalus robbinsii var. minor	Robbins' Milkvetch	S1		
Astragalus tenellus	Loose-flower Milk-vetch	S3		
Athyrium alpestre		S1		

ssp. americanum				
Athyrium filix-femina	Subarctic Lady-fern	S2S3		
Athyrium filix-femina var. cyclosorum		S2S3		
Betula pumila	Swamp Birch	S2		
Betula pumila var. glandulifera	Dwarf Birch	S2		
Bidens cernua	Nodding Beggar-ticks	S2		
Botrychium hesperium	Western Moonwort	S1		
Botrychium lanceolatum	Triangle Grape-fern	S2		
Botrychium lanceolatum var. lanceolatum	Lance-leaved Moonwort	S2		
Botrychium lineare	Narrow-leaf Grape-fern	S1		
Botrychium multifidum	Leathery Grape-fern	S1		
Botrychium pinnatum	Northern Moonwort	S2S3		
Botrychium spathulatum	Spoon-leaf Moonwort	S1S2		
Botrychium tunux	Tunux' Moonwort	S1		
Botrychium virginianum	Rattlesnake Fern	S2		
Botrychium yaaxudakeit	Yaa Xu da Keit's Moonworts	S1		
Braya glabella	Smooth Rockcress	S3		
Braya glabella ssp. glabella		S2S3		
Braya glabella ssp. purpurascens		S2		
Calamagrostis deschampsioides	Circumpolar Small-reedgrass	S2S3		
Callitriche anceps	Large Water-starwort	S1S2		
Callitriche anceps	Large Water-starwort	S1S2		
Caltha leptosepala	Slender-sepal Marsh-marigold	S2		
Caltha natans	Floating Marsh-marigold	S2		
Campanula rotundifolia	Round-leaved Harebell	S2		
Carex albonigra	Two-tone Sedge	S2		
Carex aquatilis ssp. stans		S2S3		
Carex arcta	Northern Clustered Sedge	S2		
Carex bebbii	Bebb's Sedge	S1S3	S2S3	
Carex bicolor	Two-color Sedge	S2	S3	
Carex bonanzensis	Yukon Sedge	S3		
Carex buxbaumii	Buxbaum's Sedge	S2	S2S3	
Carex deweyana	Short-scale Sedge	S2		
Carex deweyana var. deweyana	Short-scale Sedge	S2		

Carex eburnea	Ebony Sedge	S2S3		
Carex eleusinoides	A Sedge	S3		
Carex flava	Yellow Sedge	S1		
Carex glareosa	Lesser Saltmarsh Sedge	S2S3	S3	
Carex glareosa ssp. glareosa	Salt Marsh Sedge	S2S3	S3	
Carex heleonastes	Hudson Bay Sedge	S1		
Carex holostoma	Arctic Marsh Sedge	S1	S1S2	
Carex incurviformis	Curved Spiked Sedge	S2S3		
Carex interior	Inland Sedge	S1S2		
Carex krausei		S3		
Carex lapponica		S2		
Carex lasiocarpa	Slender Sedge	S2		
Carex laxa	Weak Sedge	S1		
Carex lenticularis var. dolia	Goose-grass Sedge	S1		
Carex lenticularis var. lipocarpa	A Sedge	S1		
Carex livida	Livid Sedge	S2S3		
Carex mackenziei	Mackenzie Sedge	S1	S3	Locally abundant and often dominating local habitats
Carex macrochaeta	Alaska Large Awn Sedge	S2		
Carex marina	Marine Sedge	S1S2	S1	many of the specimens reported to be C.marina have been reidentified
Carex maritima	Seaside Sedge	S3		
Carex nigricans		S1		
Carex norvegica	Scandinavian Sedge	S1		
Carex oligosperma		S1		
Carex pachystachya	A Sedge	S1S2		
Carex parryana	Parry Sedge	S2S3		
Carex pauciflora	Few-flowered Sedge	S1		
Carex peckii	White-tinged Sedge	S1		
Carex phaeocephala	A Sedge	S2S3		
Carex praegracilis	Clustered Field Sedge	S2S3		
Carex prairea	Prairie Sedge	S1		
Carex ramenskii	Ramenski Sedge	S1	S2S3	More common than previously thought
Carex rostrata	Beaked Sedge	S2	S3	
Carex sabulosa	Sand Sedge	S2		
Carex sabulosa ssp. leiophylla		S2		
Carex sartwellii	Sartwell's Sedge	S1		
Carex siccata		S1		
Carex spectabilis	A Sedge	S1		

Carex stylosa	Long-styled Sedge	S2		
Carex subspathacea		S2	S3S4	widespread and locally common along the coast
Carex sychnocephala	Many-headed Sedge	S2		
Carex ursina	Bear Sedge	S2	S3	widespread along the coast
Carex viridula	Little Green Sedge	S3		
Carex viridula ssp. viridula	Green Sedge	S3		
Carex williamsii	A Sedge	S2S3	S3	
Carex xerantica	Dry-land Sedge	S1		
Cassiope mertensiana	White Mountain Heather	S1		
Castilleja miniata	Greater Red Indian-paintbrush	S1S2	S2	most sites remote with few threats, large local populations
Castilleja parviflora	Small-flowered Indian-paintbrush	S2		
Castilleja parviflora var. parviflora		S2		
Castilleja yukonis	Yukon Indian-paintbrush	S3		
Ceratophyllum demersum	Common Hornwort	S2	S2S3	
Chenopodium glaucum	Oakleaf Goosefoot	S1		
Chenopodium leptophyllum	Narrowleaf Goosefoot	S1		
Chenopodium rubrum	Red Goosefoot	S3		
Chenopodium salinum		S1		
Chenopodium simplex	Giant-seed Goosefoot	S1		
Chimaphila umbellata		s1		
Chimaphila umbellata ssp. occidentalis		S1		
Chrysanthemum arcticum	Arctic Daisy	S1S3	S3	more widespread than previously thought along the coast
Chrysanthemum arcticum ssp. polare	Arctic Daisy	S1S3	S3	more widespread than previously thought along the coast
Cicuta bulbifera	Bulb-bearing Water-hemlock	S2		
Cicuta maculata	Spotted Water-hemlock	S2S3		

Cicuta maculata var. angustifolia	Spotted Water-hemlock	S2	S2S3	
Cicuta virosa	European Water-hemlock	S3		
Cinna latifolia	Slender Wood Reedgrass	S2S3		
Circaea alpina ssp. alpina	Small Enchanter's Nightshade	S2	S2S3	
Cirsium foliosum	Leafy Thistle	S2		
Claytonia megarhiza		S1		
Claytonia ogilviensis	Ogilvie Mountains Spring Beauty	S1		
Claytonia scammaniana	Scamman's Springbeauty	S3		
Coeloglossum viride	Bracted Green Orchid	S2	S2S3	
Coeloglossum viride ssp. bracteatum	Bracted Green Orchid	S2	S2S3	
Collinsia parviflora	Small-flower Blue-eyed Mary	S2		
Colpodium vahlianum	Vahl's Alkali Grass	S1		
Comandra umbellata	Umbellate Bastard Toad-flax	S1S2		
Comandra umbellata ssp. pallida	Pale Comandra	S1	S1S2	
Corispermum ochotense	Russian Bugseed	S2		
Corispermum ochotense var. alaskanum	Russian Bugseed	S2		
Crassula aquatica	Pigmyweed	S1		
Cryptogramma crispa var. acrostichoides	Mountain Parsley	S2S3		
Cryptogramma crispa var. sitchensis	Sitka Parsley Fern	S2		
Cryptogramma stelleri	Fragile Rockbrake	S2		
Cynoglossum virginianum var. boreale	Northern Wild Comfrey	S1		
Cypripedium guttatum	Spotted Lady's-slipper	S2		
Cypripedium parviflorum	Small Yellow Lady's-slipper	S1		
Danthonia spicata	Poverty Oat-grass	S1		
Delphinium brachycentrum	Northern Larkspur	S1		
Descurainia incisa var. incisa		S2		
Descurainia pinnata	Pinnate Tansy-mustard	S1S2		

Descurainia pinnata ssp. nelsonii		S1S2		
Dianthus repens	Carnation	S2		
Diapensia lapponica	Lapland Diapensia	S3		
Diapensia lapponica ssp. obovata	Diapensia	S3		
Dodecatheon pulchellum	Few-flower Shooting-star	S2		
Dodecatheon pulchellum ssp. pulchellum		S2		
Douglasia alaskana	Alaska Rockjasmine	S1		
Douglasia arctica	Mackenzie River Douglasia	S3	S3S4	
Draba albertina	Slender Whitlow-grass	S3		
Draba corymbosa	Flat-top Whitlow-grass	S3		
Draba kananaskis	Longstalk Whitlow-grass	S1		
Draba kluanei	Kluane Park Whitlow-grass	S1		
Draba lonchocarpa var. vestita		S1		
Draba macounii	Macoun's Whitlow-grass	S3		
Draba murrayi	Murray's Whitlow-grass	S1		
Draba nemorosa	Wood Whitlow-grass	S2S3		
Draba nemorosa var. leiocarpa	Wood Whitlow-grass	S2S3		
Draba ogilviensis	Ogilvie Range Whitlow-grass	S3		
Draba porsildii	Porsild's Whitlow-grass	S2		
Draba ruaxes	Rainier Whitlow-grass	S2		
Draba scotteri	Scotter's Whitlow-grass	S2S3		
Draba stenoloba	Alaska Whitlow-grass	S3		
Draba stenopetala	Star-flowered Draba	S2		
Draba ventosa	Wind River Whitlow-grass	S1		
Draba yukonensis	Yukon Whitlow-grass	S1		
Drosera anglica	English Sundew	S2S3	S3	
Dryopteris carthusiana	Spinulose Shield Fern	S2		
Dryopteris expansa	Spreading Woodfern	S2S3		
Eleocharis uniglumis	Creeping Spike-rush	S2		
Epilobium arcticum		S2	S1S2	
Epilobium clavatum	Clavate-fruit Willow-herb	S1		
Epilobium davuricum	Dahuria Willow-herb	S2	S2S3	
Erigeron compositus var. discoideus		S1		
Erigeron glabellus	Smooth Fleabane	S3		
Erigeron glabellus var. pubescens		S3		
Erigeron grandiflorus	Large-flower Fleabane	S2S3		
Erigeron		S2S3		

grandiflorus ssp. arcticus				
Erigeron hyperboreus	Boreal Fleabane	S1		
Erigeron hyssopifolius	Daisy Fleabane	S3		
Erigeron mexiae		S1	synonym	synonym of E.pallens (E.denali)
Erigeron muirii	Muir's Fleabane	S1		
Erigeron ochroleucus		S1		
Erigeron pallens		S3		
Erigeron peregrinus ssp. callianthemus		S1		
Erigeron peregrinus ssp. peregrinus		S2		
Erigeron philadelphicus	Philadelphia Fleabane	S2		
Erigeron philadelphicus var. philadelphicus	Philadelphia fleabane	S2		
Erigeron yukonensis	Yukon Fleabane	S2		
Eriogonum flavum	Umbrella Plant	S1	S1S2	
Eriogonum flavum var. aquilinum	Umbrella Plant	S1	S1S2	
Eriophorum gracile	Slender Cotton-grass	S1S2	S2S3	Rhonda has made many recent collections
Eriophorum gracile var. gracile	Slender Cotton-grass	S1S2	S2S3	
Eriophorum vaginatum ssp. spissum		S1S3		
Eriophorum viridicarinatum	Green Keeled Cottongrass	S2		
Eritrichium chamissonis	Arctic-alpine Forget-me-not	S1		
Eritrichium splendens	Showy Forget-me-not	S2		
Erysimum angustatum	Dawson Wallflower	S2		
Erysimum inconspicuum	Small-flower Prairie Wallflower	S1		
Festuca brevissima		S2S3		
Festuca hyperborea	Boreal Fescue	S1		
Festuca lenensis		S1	S3	
Festuca minutiflora		S1S2		
Festuca saximontana var. purpusiana		S2		

Fritillaria camschatcensis	Indian Rice	S1		
Galium triflorum	Sweet-scent Bedstraw	S3		
Gentianella tenella ssp. tenella	Slender Gentian	S2		
Gentianopsis detonsa	Sheared Gentian	S3		
Gentianopsis detonsa ssp. yukonensis		S3		
Geranium richardsonii	Richardson Geranium	S2		
Geum triflorum	Prairie-smoke	S1		
Glaux maritima ssp. maritima		S2		
Glyceria borealis	Small Floating Manna-grass	S2	S2S3	
Glyceria striata var. stricta	Fowl Manna-grass	S2S3		
Gymnocarpium jessoense	Northern Oak Fern	S2S3		
Gymnocarpium jessoense ssp. parvulum	Nahanni Oak Fern	S2S3		
Halimolobos mollis	Soft Rockcress	S3		
Harrimanella stelleriana	Starry Bell-heather	S2		
Helictotrichon hookeri	Spike-oat	S2		
Hieracium albiflorum	White-flowered Hawkweed	S1		
Hierochloe pauciflora	Few-leaved Sweet-grass	S1	S3	more common than previously thought
Hippuris montana	Mountain Mare's-tail	S1	SNR	there are some doubts about the identification of this single collection
Hippuris tetraphylla	Fourleaf Mare's-tail	S1	S3S4	More common than previously thought
Hordeum brachyantherum	Meadow Barley	S2		
Iris setosa var. interior		S1		
Isoetes echinospora	Spiny-spored Quillwort	S1		
Isoetes maritima		S1		
Juncus nodosus	Knotted Rush	S2S3		
Juncus stygius	Moor Rush	S2		
Juncus stygius ssp. americanus	Moor Rush	S2		
Juncus triglumis	Three-flower Rush	S1S2		

Koeleria asiatica	Oriental Junegrass	S2		
Koeleria macrantha	Prairie Junegrass	S2		
Koenigia islandica	Island Koenigia	S2	S2S3	
Krascheninnikovia lanata	Winter-fat	S1		
Lactuca biennis	Tall Blue Lettuce	S1		
Lathyrus japonicus	Beach Pea	S1	S2S3	more common than previously thought
Lathyrus ochroleucus		S2		
Lesquerella calderi	Calder's Bladder-pod	S3		
Lewisia pygmaea	Alpine Bitteroot	S1		
Limosella aquatica	Northern Mudwort	S2S3		
Linnaea borealis ssp. borealis		S1	S1S3	
Lomatogonium rotatum	Marsh Felwort	S1	S4	widespread
Lupinus kuschei	Yukon Lupine	S3	S3S4	
Lupinus nootkatensis	Nootka Lupine	S1S2		
Luzula groenlandica	Greenland Wood-rush	S1		
Luzula wahlenbergii		S2	S3	
Lycopodium dendroideum	Treelike Clubmoss	S1		
Lycopodium sitchense	Sitka Club-moss	S1		
Lysimachia thyrsiflora	Water Loosestrife	S2		
Malaxis paludosa	Bog Adder's-mouth	S1	S1S2	new populations discovered
Matricaria ambigua	Sea-shore Chamomile	S1S2		
Mertensia maritima	Sea Bluebells	S2?	S2	
Mertensia paniculata var. alaskana		S2		
Minuartia rossii	Ross' Stitchwort	S2		
Mitella pentandra	Five-point Bishop's-cap	S2		
Montia bostockii	Bostock's Miner's-lettuce	S2S3	S3	
Montia fontana	Fountain Miner's-lettuce	S1	S2S3	more common than previously thought
Muhlenbergia glomerata	Marsh Muhly	S1		
Muhlenbergia richardsonis	Mat Muhly	S2		
Najas flexilis	Wavy Waternymph	S1		
Oplopanax horridus	Devil's-club	S1S2	S2	more widespread than previously thought - new populations found in SE Yukon

Orthocarpus luteus	Yellow Owl's-clover	S1		
Oryzopsis asperifolia	White-grained Mountain-ricegrass	S1	S2S3	more common than previously thought
Oxytropis arctica var. arctica		S1		
Oxytropis arctica var. murrayi		S1		
Oxytropis campestris ssp. roaldii		S3	S2S3	
Oxytropis huddelsonii	Huddelson's Crazy-weed	S3		
Oxytropis mertensiana	Mertens' Crazy-weed	S1		
Oxytropis nigrescens ssp. lonchopoda		S1	S1S3	taxonomic and distributional uncertainty exists
Papaver alboroseum	Pale Poppy	S1		
Papaver gorodkovii		S1		
Papaver mcconnellii	Mcconnell's Poppy	S3	S3S4	
Papaver nudicaule ssp. americanum		S2		
Papaver radicatum ssp. radicatum		S1		
Papaver walpolei	Walpole Poppy	S2		
Parietaria pensylvanica	Pennsylvania Pellitory	S1		
Pedicularis groenlandica	Bull Elephant's-head	S2		
Pedicularis macrodonta	Muskeg Lousewort	S2		
Phacelia mollis	Coffee Creek Scorpion-weed	S2S3		
Phalaris arundinacea	Reed Canary Grass	S2		
Phalaris arundinacea	Reed Canary Grass	S2		
Phegopteris connectilis	Northern Beech Fern	S1		
Phippsia algida	Ice Grass	S2	S2S3	
Phlox richardsonii	Richardson's Phlox	S3		
Phyllodoce glanduliflora	Yellow Mountain-heath	S2S3		
Pinguicula macroceras	California Butterwort	s1		
Pinguicula macroceras var. macroceras	Horned Butterwort	s1		
Plantago maritima	Seaside Plantain	S1		
Platanthera dilatata	Leafy White Orchis	S3		

Platanthera orbiculata	Large Roundleaf Orchid	S2S3		
Platanthera stricta	Slender Bog Orchid	S1		
Poa abbreviata ssp. abbreviata		S1		
Poa abbreviata ssp. pattersonii	Patterson Bluegrass	S1		
Poa arctica ssp. williamsii		S1		
Poa cusickii	Cusick's Bluegrass	S2		
Poa interior	Inland Bluegrass	S2		
Poa porsildii		S3		
Poa pseudoabbreviata	Polar Bluegrass	S1		
Podistera macounii	Macoun's Podistera	S2S3		
Podistera yukonensis	Yukon Podistera	S1		
Polygonum caurianum ssp. caurianum		S1	S2	2 records occur for this species I think the ssp. record can be deleted as no other ssp. known
Polygonum lapathifolium	Dock-leaf Smartweed	S2		
Polygonum lapathifolium var. lapathifolium	Hedge Cornbind	S2		
Polygonum pensylvanicum ssp. oneillii		S1S2		
Polypodium sibiricum		S1		
Polystichum lonchitis	Northern Holly-fern	S1		
Potamogeton foliosus	Leafy Pondweed	S2		
Potamogeton obtusifolius	Blunt-leaf Pondweed	S1		
Potamogeton strictifolius	Straight-leaf Pondweed	S1		
Potamogeton subsibiricus	Yenisei River Pondweed	S1		
Potentilla bimundorum	Divided Cinquefoil	S2S3	S3S4	
Potentilla bipinnatifida		S2		
Potentilla egedii	Egede Cinquefoil	S1S2	S3S4	widespread and locally common along the coast
Potentilla gracilis	Slender Cinquefoil	S2		
Potentilla ovina	Sheep Cinquefoil	S1?	SNR	specimens should

				be reviewed
Potentilla pulchella	Pretty Cinquefoil	S2		
Potentilla rubricaulis	Rocky Mountain Cinquefoil	S2		
Primula borealis		S2	S3	more common along the coast than previously thought
Primula egaliksensis	Greenland Primrose	S2S3		
Primula eximia		S2S3		
Primula mistassinica	Bird's-eye Primrose	S2		
Primula nutans		S2S3	S3	
Prunella vulgaris ssp. lanceolata		S1		
Puccinellia angustata		S1		
Puccinellia arctica	Arctic Alkali Grass	S2S3		
Puccinellia grandis	Pacific Alkali Grass	S1		
Puccinellia hauptiana		S1		
Puccinellia langeana		S1	S2S3	widespread but not abundant along the coast
Puccinellia phryganodes	Creeping Alkali Grass	S2	S3S4	common throughout the coast
Puccinellia vaginata	Arctic Tussock Alkali Grass	S2	S3	
Ranunculus occidentalis var. brevistylis		S2	S3	locally common and the majority of populations occur in Kluane National Park
Ranunculus pallasii	Pallas Buttercup	S3		
Ranunculus turneri	Turner's Butter-cup	S2S3		
Ribes laxiflorum	Trailing Black Currant	S1		
Rorippa barbareifolia	Hoary Yellow-cress	S3		
Rosa woodsii	Woods Rose	S2		
Rubus arcticus ssp. stellatus	Beringian Nagoonberry	S2	S1S2	not enough known populations to be considered S2
Rubus pedatus	Five-leaf Dwarf Bramble	S1		
Rumex acetosa	Green Sorrel	S1		
Rumex acetosa ssp. alpestris	Green Sorrel	S1		
Rumex beringensis	Bering Sea Dock	S1	S1S2	local populations large and within a protected area
Rumex maritimus	Sea-side Dock	S3		
Ruppia spiralis	Ditch-grass	S1		
Sagina nivalis	Snow Pearlwort	S1	S3S4	more common

				than previously thought, primarily along the coast and AsiKeyi
Sagina saginoides	Arctic Pearlwort	S2S3		
Sagittaria cuneata	Wapatum Arrowhead	S2		
Salix arctophila	Northern Willow	S2		
Salix brachycarpa ssp. brachycarpa		S2		
Salix candida	Hoary Willow	S2		
Salix chamissonis	A Willow	S3	S3S4	
Salix farriae	Farr's Willow	s2s3		
Salix lucida ssp. caudata		S1S3		
Salix maccalliana	Mccall's Willow	S1		
Salix ovalifolia	Oval-leaf Willow	S3		
Salix pedicellaris	Bog Willow	S1S3		
Salix prolixa	Mackenzie Willow	S1		
Salix pyrifolia	Balsam Willow	S2		
Salix raupii	Raup's willow	S1		
Salix rotundifolia ssp. rotundifolia		S2	S2S3	less at risk as most of the populations are within Ivvavik National Park
Salix setchelliana	A Willow	S3		
Sambucus racemosa	Red Elderberry	S1		
Sambucus racemosa ssp. pubens	Red Elderberry	S1		
Saussurea americana	American Saw-wort	S1		
Saxifraga bronchialis ssp. codyanus		S2	S1	
Saxifraga eschscholtzii	Cushion Saxifrage	S2		
Saxifraga foliolosa	Leafy Saxifrage	S2S3		
Saxifraga nelsoniana ssp. pacifica		S2		
Saxifraga spicata	Spiked Saxifrage	S1	SH	not seen since 1920. Habitat potentially disturbed or destroyed by mining.
Scheuchzeria palustris ssp. americana	American Scheuchzeria	S2S3		
Schizachne	Purple Oat	S2S3		

purpurascens				
Schoenoplectus acutus	Hard-stem Bulrush	S3	duplicate	
Scirpus acutus	Hard-stem Bulrush	S3		
Scirpus hudsonianus	Hudson Bay Clubrush	S2S3		
Scirpus microcarpus	Small-fruit Bulrush	S2S3		
Scirpus rollandii	Rolland Bulrush	S2		
Scirpus rufus	Red Bulrush	S1		
Scirpus validus	Soft-stem Bulrush	S1S2	S2	
Scolochloa festucacea	Sprangle-top	S1		
Scutellaria galericulata var. pubescens	Narrow-leaved Skullcap	S2S3		
Senecio hyperborealis	Boreal Groundsel	S2S3		
Senecio sheldonensis	Mount Sheldon Groundsel	S2		
Silene involucrata ssp. tenella	Peel River Catchfly	S3		
Silene menziesii	Menzies Pink	S3		
Silene uralensis ssp. ogilviensis	Ogilvie Mountains Nodding Campion	S2		
Silene williamsii	Williams' Campion	S1S2		
Sisyrinchium montanum	Strict Blue-eyed-grass	S2		
Sium suave	Hemlock Water-parsnip	S2		
Solidago canadensis	Canada Goldenrod	S3		
Solidago canadensis var. salebrosa		S3		
Sorbus sitchensis	Sitka Mountain-ash	S1	S2	locally common
Sphenopholis intermedia		S1		
Stellaria alaskana	Alaska Starwort	S1		
Stellaria dicranoides	Matted Starwort	S1		
Stellaria humifusa	Creeping Sandwort	S2	S3S4	common throughout the coast
Stellaria umbellata	Umbellate Stitchwort	S1S2	S2	
Stenotus macleanii	Northern Mock Golden-weed	S2		
Stipa nelsonii ssp. dorei	Columbia Needlegrass	S2		
Stipa richardsonii	Canada Mountain Ricegrass	S2		
Suaeda calceoliformis	American Sea-blite	S2S3		
Subularia aquatica	Water Awlwort	S2S3		

var. americana				
Swertia perennis		S1		
Synthyris borealis	Alaska Kitten-tail	s2s3	S3	
Tanacetum bipinnatum ssp. bipinnatum		S1	SNR	taxonomic uncertainty
Taraxacum carneocoloratum	Flesh-coloured Dandelion	S1		
Taraxacum integratum		S1	?	check these
Taraxacum maurolepium		S1	?	check these
Thalictrum venulosum	Veined Meadowrue	S1		
Thellungiella salsuginea	Saltwater Cress	S2		
Thlaspi arcticum	Arctic Pennycress	S1S2		
Tofieldia glutinosa	Sticky False-asphodel	S2S3		
Tofieldia glutinosa ssp. glutinosa	Sticky False Asphodel	S2S3		
Torreyochloa pauciflora	Weak False Manna	S1		
Townsendia hookeri	Hooker Townsend	s2s3		
Toxicodendron rydbergii	Poison Ivy	S1		
Trientalis borealis ssp. latifolia	Northern Starflower	S2S3		
Trisetum sibiricum	Siberian False-oats	S1	SH	not seen since 1940. Not seen in recent surveys
Trisetum sibiricum ssp. litorale	Siberian False-oats	S1	SH	
Trisetum sibiricum ssp. sibiricum		S1	SH	
Typha latifolia	Broad-leaf Cattail	S2		
Utricularia minor	Lesser Bladderwort	S2S3		
Vaccinium membranaceum	Tall Blueberry	S2		
Vaccinium ovalifolium	Oval-leaf Huckleberry	S2S3		
Vahlodea atropurpurea	Mountain Hairgrass	S3		
Veronica scutellata	Marsh-speedwell	S3		
Vicia americana	American Purple Vetch	S2	S3	less at risk from ability to colonize areas
Viola biflora	Northern Violet	S1		
Viola biflora ssp. biflora		S1		
Viola canadensis	Canada Violet	S2S3		
Viola canadensis ssp. rydbergii	Canada Violet	S2S3		

Viola langsdorfii	Aleutian Violet	S2		
Viola nephrophylla	Northern Bog Violet	S1		
Viola selkirkii	Great-spurred Violet	S1		
Woodsia ilvensis	Rusty Woodsia	S1	S2	more widespread than previously thought - likely overlooked - none are known from a protected area
Woodsia scopulina	Rocky Mountain Woodsia	S1		
Woodsia scopulina ssp. scopulina	Rocky Mountain Woodsia	s1		
Zannichellia palustris	Horned Pondweed	S1		

*Vascular Plant Species Ranked in the Yukon Territory by the General Status of Species in Canada (Wild Species, 2005).