APPENDIX 35

Pacific Booker Minerals Inc.
Morrison Copper/Gold Project
British Columbia, Canada

Morrison Copper/Gold Project Ecosystem Mapping and Vegetation Baseline Report




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Executive Summary

This report presents the ecosystem mapping and vegetation baseline study for Pacific Booker Minerals Inc (PBM).

PBM's proposed Morrison Copper/Gold Project (the Project) is 65 km northeast of Smithers and 35 km north of the village of Granisle in north-central British Columbia. The Project is on the east side of Morrison Lake on Crown land and falls within the traditional territory of the Lake Babine Nation. Access to the Project site is by road with barge access across Babine Lake, which is 50 km south of the site. The Project is approximately 35 km north of the former Bell and Granisle copper/gold mines.

The Morrison mine will be a 30,000 tpd open pit operation with ore processed in a conventional milling plant and the copper/gold concentrate transported to the Port of Stewart for shipment to offshore smelters. Molybdenum concentrate will be trucked from the mine to a refinery location to be confirmed. The mine will produce approximately 224 Mt of tailings and 170 Mt of waste rock.

The information contained in this baseline is intended to support a full environmental and socio-economic impact assessment of the Project.

The objective of this study was to describe the existing vegetation and ecosystems in the Project area and surrounding region.

Field investigations and research focused on general characterization of the ecological community structure to refine the ecosystem map for the footprint area. Particular emphasis was placed on identifying ecosystem units, as well as plant species and ecosystems of conservation concern. Ecosystems within the regional study area were mapped using Predictive Ecosystem Mapping (PEM), and those within the local study and footprint areas were mapped using Terrestrial Ecosystem Mapping (TEM).

The regional study area includes four Biogeoclimatic Ecosystem Classification units: Sub-boreal Spruce moist cold subzone – Babine variant (SBSmc2), Engelmann Spruce Subalpine Fir moist very cold subzone – Omineca variant (ESSFmv3), Engelmann Spruce Subalpine Fir moist cold (ESSFmc) subzone, and Sub-boreal Spruce wet cool subzone – Takla variant (SBSwk3). The footprint area is predominantly within the SBSmc2, though a portion is within the ESSFmv3 biogeoclimatic unit.

During September, 2006, and July, 2008, 107 survey plots were established in the local study area. The majority of these were forested ecosystems. The dominant ecosystem in both the footprint and the local study area is mesic forest. Of the non-forested ecosystem types, water is the most dominant largely because of the partial inclusion of Morrison Lake in the local study area. Within the footprint area, forests are predominately young to mature, while in the local study area, forests are predominantly mature.

No plant species of conservation concern tracked by the British Columbia Conservation Data Centre (BC CDC) or the Committee on the Status of Endangered Wildlife in Canada were identified within the study areas. Two red-listed ecosystem tracked by the BC CDC were identified during field studies using PEM: Saskatoon - slender wheatgrass (SBSmc2 81), which covered 75 ha in the regional study area, and Sandberg's bluegrass - slender wheatgrass (SBSmc2 82), which was found throughout the local and regional study areas (1,493 ha total). Both ecosystems are red-listed (provincially extirpated, endangered, or threatened), with the former provincially ranked as imperilled and the latter ranked as critically imperilled. Two blue-listed drier forest ecosystems were also mapped within the regional study area using PEM: lodgepole pine/black huckleberry/reindeer lichens (SBSwk3 02), which covered 32 ha, and Douglas-fir - hybrid white spruce/thimbleberry (SBSwk3 03), which covered 64 ha.

Two invasive plants were identified within the local study area: water hemlock (*Cicuta douglasii*) and common horsetail (*Equisetum arvense*). Water hemlock is a highly toxic, native member of the parsnip family that typically grows in moist areas near streams and wetlands. Common horsetail is widespread throughout the province and is not considered a significant concern within the proposed Project area; neither species is regulated by the *BC Weed Control Act*.

Plant tissue samples were collected at 49 field sites in 2006, 2007, and 2008 to establish baseline metal concentrations for future monitoring during mine operations and following mine closure and reclamation. Samples were tested for 24 (2006) or 28 (2007, 2008) metals. Many of these metals (39% to 58%, depending on the year and species) were below the detection limits. Metal concentrations varied by species and tissue type. Total and average plant tissue metal concentrations between the proposed mine facilities area and the transmission line study corridor were similar over the three sampling years.

Acknowledgements

This report was prepared for Pacific Booker Minerals Inc. by Rescan Environmental Services Ltd. The project was managed by Rolf Schmitt. Greg Sharam was responsible for managing the ecosystem mapping and vegetation studies component. Natasha Bush and Shanley Thompson authored the report with editorial assistance provided by Greg Sharam and Nicole Tenant. Field work was completed by Todd Mahon (2006) and Daniel McAllister (2008). Dan McAllister completed the Terrestrial Ecosystem Mapping. Metals analyses were conducted by ALS Laboratory Group, and summarized by Rick Lee. Luke Powell, Pieter van Leuzen, and Michael Stead (GIS specialists) were responsible for managing and displaying the geospatial data. Lorraine Gevatkoff (Desktop Publisher) and Jason Widdes (Graphic designer) were responsible for report production.

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Morrison Copper/Gold Project Ecosystem Mapping and Vegetation Baseline Report

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Glossary, Acronyms, and Abbreviations

Alpine	Non-forested land at upper elevations above the tree line. Low shrubs, herbs, bryophytes, and lichens dominate alpine vegetation on zonal sites. Alpine is considered to be above parkland forest. Although treeless by definition, rare stunted (krummholz) trees may occur. Much of the alpine will be non-vegetated, covered primarily by rock and ice.
Attribute	Any feature of an ecosystem unit that is not represented by the site series/ecosystem unit, site modifier, or structural stage. Attributes may either be recorded from fieldwork or inferred by extrapolating features from similar ecosystem units.
BC CDC	British Columbia Conservation Data Centre
BC MAL	British Columbia Ministry of Agriculture and Lands
BC MELP	British Columbia Ministry of Environment, Lands and Parks
BC MOE	British Columbia Ministry of Environment
BC MOF	British Columbia Ministry of Forests
BC MOFR	British Columbia Ministry of Forests and Range
BC MSRM	British Columbia Ministry of Sustainable Resource Management
BEC	Biogeoclimatic Ecosystem Classification. Provincial hierarchical classification scheme identifying geographic areas under the influence of the same regional climate. Individual areas are classified as biogeoclimatic units under a hierarchy of biogeoclimatic zone, subzone, variants, and phases.
Biogeoclimatic subzone	Basic unit in the BEC system, consisting of unique sequences of geographically related ecosystems, influenced by one type of regional climate. The subzone describes the zonal/or climax vegetation, and corresponding climate and soil.
Biogeoclimatic unit	A general term referring to any level of biogeoclimatic zone, subzone, variant or phase. Biogeoclimatic units are inferred from a system of ecological classification based on a floristic hierarchy of plant associations. The recognized units are a synthesis of climate, vegetation, and soil data.
Biogeoclimatic variant	A further subdivision of biogeoclimatic subzone reflecting further differences in regional climate. Variants are described as warmer, colder, drier, wetter, or snowier than the "typical" subzone (e.g., ESSFmm1-moist mild raush Engelmann Spruce-Subalpine Fir).
Biogeoclimatic zone	Geographical areas having similar patterns of energy-flow, vegetation, and soils as a result of a broadly homogeneous macroclimate. Biogeoclimatic zones are composed of biogeoclimatic subzones with similar zonal climax ecosystems.
Blue-list	List of ecological communities, and indigenous species and subspecies of special concern (formerly vulnerable) in British Columbia.
COSEWIC	Committee on the Status of Endangered Wildlife in Canada. A committee that produces the official list of Canada's endangered species.

DEM	Digital Elevation Model. Series of mass points and breaklines defining the earth's surface.
DND	Nadina Forest District
Ecosystem (terrestrial)	A volume of earth-space that is composed of non-living parts (climate, geologic materials, groundwater, and soils) and living or biotic parts, which are all constantly in a state of motion, transformation, and development. No size or scale is inferred.
Ecosystem Unit	A classification unit defined as a combination of site unit, site modifiers, and structural stage (and sometimes seral community type).
ESSF	Engelmann Spruce Subalpine Fir zone
ESSFmc	Engelmann Spruce Subalpine Fir moist cold subzone
ESSFmv3	Engelmann Spruce Subalpine Fir moist very cold subzone - Omineca variant
Floodplain	Area of unconsolidated, river-borne sediment in a river valley; subject to periodic flooding.
Forb	Non-graminoid herbaceous plants (e.g., cow-parsnip).
Gathering	The act of searching for food and provisions in nature
GIF	Ground Inspection Forms
GIS	Geographic Information System. A computer-based system to process spatially-referenced data into information for a specific purpose. Primary processes include data input, management, query, analysis and visualization.
Habitat	Land and water surface used by wildlife. This may include biotic and abiotic aspects such as vegetation, exposed bedrock, water and topography.
Hectare	10,000 m2 or 0.01 km2 or 2.47 acres.
Herb	A plant—annual, biennial or perennial— with stems that die back to the ground at the end of the growing season.
Invasive Plant	ıative plants that have been introduced without the insect predators and plant pathogens that help keep them in check in their native habitats. Commonly referred to as “weeds.”
LSA	Local study area
Mesic	Water removed somewhat slowly in relation to supply; soil may remain moist for a significant, but sometimes short period of the year. Available soil moisture reflects climatic inputs.
MFA	Mine facilities area
Model	An idealized representation of reality developed to describe, analyze or understand the behaviour of some aspect of it; a mathematical representation of a relationship under investigation.
Moisture regime	Indicates the available moisture for plant growth in terms of the soil's ability to hold, lose, or receive water. Described as moisture classes from Very Xeric (0) to Hydric (8) (BC MELP and BC MOF 1998).

Noxious weed	Noxious weeds are typically non-native plants. They are particularly aggressive, destructive, and difficult to control, and are regulated by the BC Weed Control Act.
Nuisance Weed	An undesirable plant species that is typically so widespread that controlling it is not economically practical. Not regulated by the BC Weed Control Act.
Nutrient regime	Indicates the available nutrient supply for plant growth on a site, relative to the supply on all surrounding sites. Nutrient regime is based on a number of environmental and biotic factors, and is described as classes from Oligotrophic (A) to Hypereutrophic (F) (BC MELP and BC MOF 1998).
PBM	Pacific Booker Minerals Inc.
PEM	Predictive Ecosystem Mapping
Pixel	Short for picture element. Smallest display unit of a digital image that can be assigned a colour. Also used for mapping—the smallest unit of mapping that is assigned attributes.
Polygon	Delineations that represent discrete areas on a map, bounded by a line. On an ecosystem map, polygons depicting ecosystem map units are nested within larger polygons containing the biogeoclimatic and ecoregion map units. Polygons depicting ecosystem units represent areas from less than one hectare to several hundred hectares, depending on the scale of mapping.
Red-list	List of ecological communities, indigenous species, and subspecies that are extirpated, endangered, or threatened in British Columbia. Red-listed species and subspecies have, or are candidates for, official Extirpated, Endangered, or Threatened Status in BC. Not all red-listed taxa will necessarily become formally designated. Placing taxa on the red list flags them as being at risk and requiring investigation.
RIC	Resources Inventory Committee
RISC	Resources Inventory Standards Committee
Riparian Habitat	Vegetation growing close to a watercourse, lake, swamp, or spring that is critical for wildlife cover, fish food organisms, stream nutrients, large organic debris and streambank stability.
RSA	Regional study area
SBS	Sub-boreal Spruce zone
SBSmc2	Sub-boreal Spruce moist cold subzone – Babine variant
SBSmc2 81	Saskatoon – slender wheatgrass
SBSmc2 82	Sandberg's bluegrass - slender wheatgrass
SBSwk3	Sub-boreal Spruce wet cool subzone – Takla variant
SBSwk3 02	Lodgepole pine/black huckleberry/reindeer lichens
SBSwk3 03	Douglas-fir - hybrid white spruce/thimbleberry
Scale	The degree of resolution at which ecological processes, structure, and changes across space and time are observed and measured. Common scales of terrestrial ecosystem mapping are 1:20,000 and 1:50,000.

Site series	Describes all land areas capable of producing the same late seral or climax plant community within a biogeoclimatic subzone or variant (Banner et al. 1993). Site series can be related to a specified range of soil moisture and nutrient regimes within a subzone or variant, but other factors, such as aspect or disturbance history may influence it as well. Site series form the basis of ecosystem units.
Structural Stage	Describes the existing dominant stand appearance or physiognomy for a land area. Factors such as disturbance history, stand age, species composition, and chance all influence structural stage. Structural stages range from non-vegetated to old forest.
Terrestrial Ecozone Classification	The Terrestrial Ecozone Classification of Canada, a nationwide framework developed by Environment Canada, provides a standardized geographical reference system for ecologically distinctive areas of the Earth's surface.
TEM	Terrestrial Ecosystem Mapping. The stratification of a landscape into map units according to a combination of ecological features, including climate, physiography, surficial material, bedrock geology, soil, and vegetation (RIC 1998).
TLSC	Transmission line study corridor
Topography	The configuration of a surface, including its relief and the position of its natural and man-made features.
TOR	Terms of Reference
TRIM	Terrain Resource Information Management. The TRIM program produces digital maps that are a collection of mapsheets covering British Columbia at a scale of 1:20,000. The mapsheets include information such as elevation (contours), anthropogenic features and natural features such as streams, lakes, etc., and official place names, such as city names, river names, etc.
TSA	Timber Supply Area
VRI	Vegetation Resources Inventory
Wetland	Semi-terrestrial sites where the water table is at, near, or above the soil surface and soils are water-saturated for a sufficient length of time such that excess water and low soil oxygen levels are principal determinants of vegetation and soils development. Wetlands must have either plant communities characterized by species that normally grow in soils that are water-saturated for a major portion of the growing season ("hydrophytes"), soils with surface peat ("O") horizons, or gleyed mineral horizons (Bg or Cg) within 30 cm of the soil surface (MacKenzie and Moran 2004).

1. Introduction

Pacific Booker Mineral Inc.'s (PBM's) proposed Morrison Copper/Gold Project (the Project) is 65 km northeast of Smithers and 35 km north of the village of Granisle in north-central British Columbia. The Project is on the east side of Morrison Lake on Crown land and falls within the traditional territory of the Lake Babine Nation (Figure 1-1).

This report presents the results of ecosystem and vegetation baseline studies that were conducted in the Project area between 2006 and 2008. This baseline information describes the ecological conditions and the spatial location and extent of ecological features, and can provide a useful context to other studies, such as wildlife habitat assessments. The ecosystem mapping and vegetation surveys provide inventory information at both a plant species and ecosystem level. Field studies were conducted in 2006 and 2008 to refine the ecosystem mapping and produce an inventory of plant species in the Project area. The presence of rare ecological communities and rare plants tracked by provincial and federal conservation agencies was also identified in the field and through the mapping process. In addition, plant tissue samples were collected to establish baseline metal concentrations for future monitoring following mine closure and reclamation.

Mapping and field surveys followed provincial standards and methodologies that were developed for BC and are widely used by resource managers throughout the province (Howes and Kenk 1997; RIC 1998, 1999). These standards and methodologies are described in more detail in Section 2.

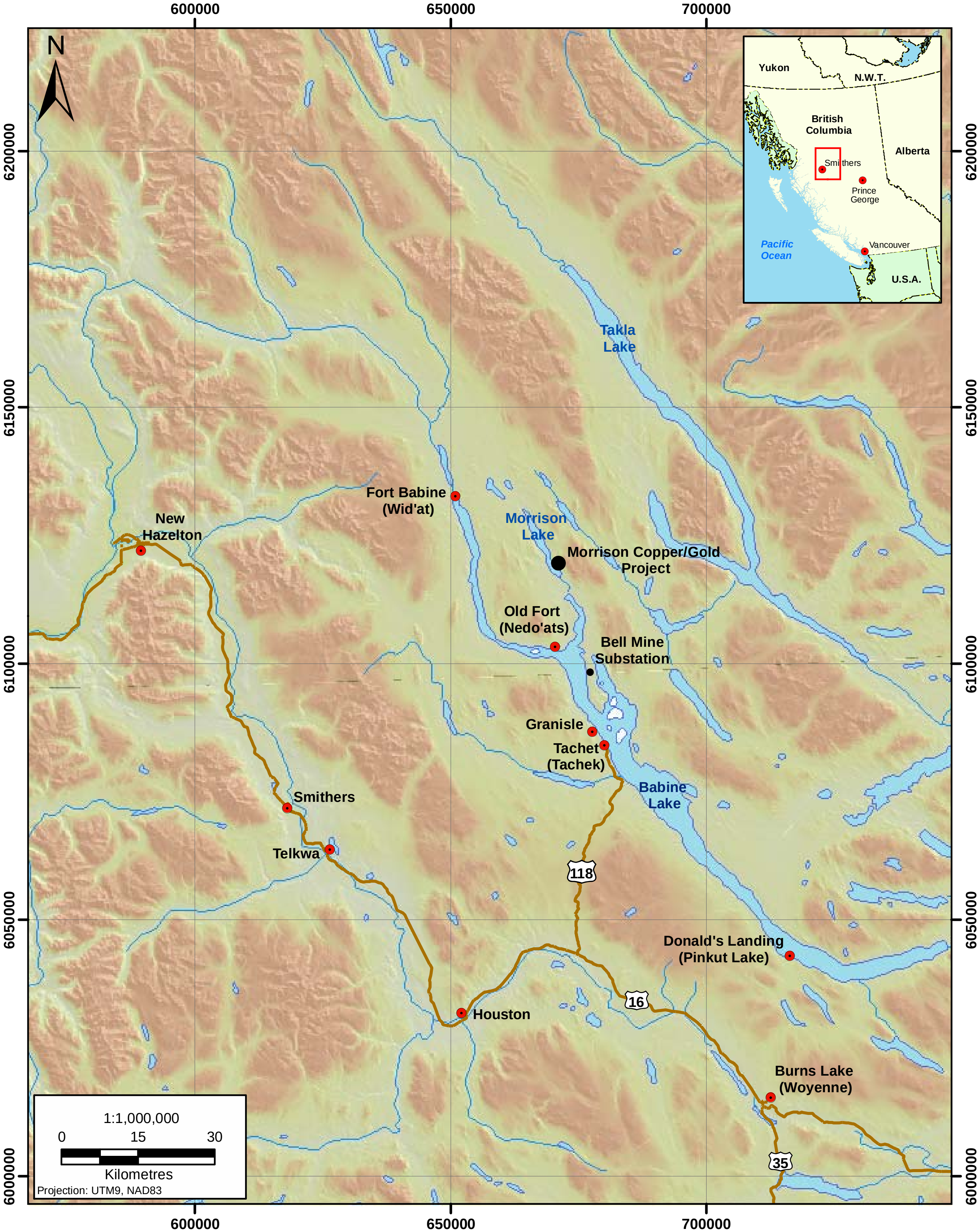

FIGURE 1-1

Morrison Copper/Gold Project
Location Map

pbm

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2. Methods

2.1 Study Area

The Project is within the Nadina Forest District and is in the Babine Upland ecosection of the Fraser basin ecoregion of the Sub-boreal Interior ecoprovince (Demarchi 1993; Environment Canada 2005). It is accessible from the highway that turns north off Highway 16 at Topley to Michelle Bay, and then by an all-season barge across Babine Lake where a main haulage logging road network extends to PBM’s Morrison property. The area has a road network established by forestry companies operating in the area.

Ecosystems and vegetation studies were conducted at three scales (Figure 2.1-1):

- the footprint
- the local study area (LSA)
- the regional study area (RSA)

The footprint study area covers 3,005 ha, and contains the mine facilities area (MFA; 1,789 ha) and the transmission line study corridor (TLSC; 1,216 ha). The MFA principally includes the pit, plant-site, waste storage facility, and haul routes/pipelines connecting facilities with a 100 m buffer surrounding the infrastructure. The TLSC currently includes three optional (100 m) buffered transmission line routes, extending from the Bell mine substation to the south end of the MFA. The LSA includes the footprint area and extends 2 km beyond footprint area boundary. The LSA covers 18,860 ha and is delimited by the Terrestrial Ecosystem Mapping (TEM) boundary. The RSA encompasses the LSA, extending 10 km beyond the MFA and TLSC boundaries. The RSA covers 108,015 ha and is delimited by the Predictive Ecosystem Mapping (PEM) boundary.

2.1.1 Biogeoclimatic Ecosystem Classification System

The Biogeoclimatic Ecosystem Classification (BEC) system is the primary means of classifying ecosystems in British Columbia (Meidinger and Pojar 1991). The BEC system is a hierarchical classification method that uses a standardized terminology and methodology to organize and present information pertaining to the ecosystems of BC. This system is based on soils, climate, and indicator plants as described by Banner et al. (1993) and Meidinger and Pojar (1991). BEC zones are at the top of the hierarchy, and are named after the dominant climax plant species. Zones are divided into subzones that reflect climate and are determined from relative precipitation and temperature regimes. Subzones may be divided into variants, which further classify subzones as slightly wetter, drier, cooler, or hotter than other areas within a subzone. The combination of zone, subzone, and variant is referred to as a BEC unit. Within each subzone, there are a series of ecosystems, termed site series, which are based on the site’s potential to produce a similar stable plant community at late successional stages (Banner et al. 1993; Cruickshank, Morrison, and Punja 1997). A full description of BEC methodology and associated terms can be found in Banner et al. (1993) and on the BC Ministry of Forests and

Range (BC MOFR; 2007) website. A brief overview of the BEC system and its application to the Project is provided below.

Site series are identified by site conditions, soil conditions, and vegetation communities and generally refer to forested ecosystems. Each site series is assigned a two-digit, numerical code. The site series that best reflects the subzone and is the least influenced by local topography and/or soil properties is termed "zonal." The zonal site series of any subzone or variant is always coded as "01." This site series typically has intermediate soil moisture (mesic) and nutrient regimes, occurs on mid-slope positions, and has moderately deep, to deep soils with unrestricted drainage (Banner et al. 1993). All other site series within the same biogeoclimatic subzone or variant are measured in relation to the zonal site (e.g., wetter or drier than zonal). Non-forested ecosystems remain largely undefined in the BEC system and are assigned the code "00." A unique two-letter code is also assigned to these units to help distinguish them.

For the purposes of this report, all site series and undefined units have been referred to as "ecosystems." In an effort to simplify report summaries, ecosystems were further categorized according to their relative moisture status and vegetation type (e.g., mesic forest, drier forest, wetland shrub). These categories have been termed "general ecosystem types" and are described in Table 2.1-1 and Appendix 1. The general ecosystem types are used to summarize ecosystem information within the Project area.

Table 2.1-1
General Ecosystem Types and Descriptions

General Ecosystem Type	Description[1]
Wetter Forest	Moist to wet forest-dominated communities
Mesic Forest	Mesic to moist forest-dominated communities
Drier Forest	Dry to mesic forest-dominated communities
Drier Shrub/Herb	Dry to mesic non-forested (e.g., grassland/scrubland) communities
Wetter Shrub/Herb	Moist to wet non-forested (e.g., grassland/scrubland) communities
Wetland Shrub/Herb	Shrub- or herb-dominated wetland communities
Water	Any waterbody, river or stream
Sparse/Un-vegetated	Sparsely vegetated and/or un-vegetated areas

[1] **Moisture Regime is relative to the BEC unit within which the ecosystem occurs.**

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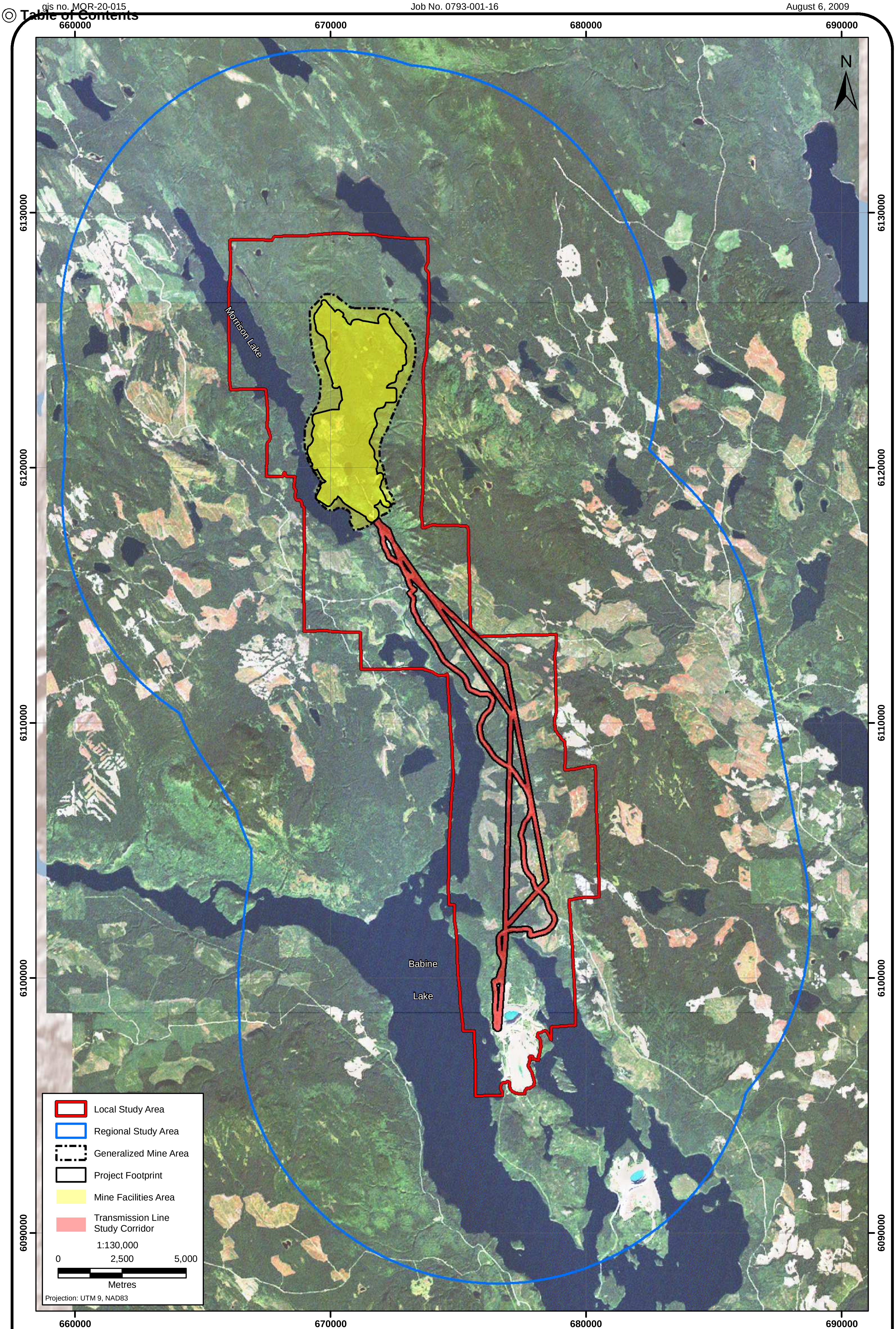


Morrison Copper/Gold Project Ecosystem and Vegetation Study Area Boundaries

FIGURE 2.1-1

2.2 Field Guide and Reference Data

The *Field Guide to Site Identification and Interpretation for the Prince Rupert Forest Region* (Banner et al. 1993) and the *Field Guide to Site Identification and Interpretation for the North Central Portion of the Northern Interior Forest Region* (MacKinnon, DeLong, and Meidinger 1990) were used to describe and classify sites. The field data collected in 2006 and 2008 in conjunction with aerial photos, biogeoclimatic maps, Terrain Resource Information Management (TRIM) data, satellite imagery, and terrain maps (where available) provided the basis for ecosystem mapping of the proposed Project area.

2.3 Ecosystem Mapping

Ecosystem mapping is a method that delineates the landscape into map units (BC MSRM 2002) according to attributes such as climate, surficial material, soil, and vegetation (RIC 1998). Two ecosystem mapping approaches exist in BC: TEM and PEM.

The standard methodology for TEM is founded on years of ecological mapping experience that has been conducted throughout the province. The approach uses air photo interpretation to identify map units (polygons) and is a two-stage process. The first stage involves the identification of permanent terrain units (which describe surficial material), while the second involves the identification of ecosystems, which are mapped within the terrain polygons. Ecosystems consist of site series (from BEC) and the characterization of vegetation age and structure (termed “structural stage”). Each ecosystem within a polygon is recorded as a decile on a scale from one to ten, which represents its proportional area within the polygon on a scale from 1 to 100 percent (e.g., 70% moist forest , 20% wetland, and 10% forested swamp; RIC 1998). There are a maximum of three deciles per polygon. Decile 1 contains the most dominant ecosystem type. Decile 2 and 3 contain the second and third most dominant ecosystem types, respectively.

PEM was developed in the early 1990s and is a model-based approach to ecosystem mapping. It makes use of available inventory and spatial data and the knowledge of ecological-landscape relationships to automate the generation of ecosystem maps (RIC 1999). The final product can be either raster- (pixel) or polygon-based, depending on the available input data, processing methodology, and desired output. Similar to TEM, a polygon-based PEM can also contain up to three separate ecosystems per polygon. A common way to display polygon-based ecosystem information is to show the dominant ecosystem. Both TEM and PEM were used in the Project area, and Project-specific details of these methods are described in the following sections.

2.3.1 Terrestrial Ecosystem Mapping

The footprint and LSA were mapped using TEM, as specified in the Project Terms of Reference (TOR) and the mine permit application requirements (BC Ministry of Energy and Mines 1998). Mapping occurred from 2007 to 2008 and was guided by the relevant provincial standards, including those for digital data capture (Howes and Kenk 1997; RIC 1998, 2000). Air photo interpretation was conducted using 1:10,000 scale 2006 colour aerial photographs for the MFA and 1:30,000 scale 2001 photographs for the TLSC. Terrain polygons were mapped in detail, which reduced the need to split polygons during the mapping of ecosystems. An ecosystem mapping legend is provided in Appendix 2. Field survey data collected in 2006 and 2008 were used to refine the ecosystem units delineated for TEM.

2.3.2 Predictive Ecosystem Mapping

PEM was used to map and describe the ecosystems in the RSA. PEM is based on provincial biogeoclimatic unit maps, forest inventory information, and various landform and topographic attributes derived from terrain data. The resulting map shows the distribution of ecosystems at a scale comparable to that commonly applied throughout the province for ecosystem mapping (1:20 000).

The PEM data used for this Project were acquired in several instalments from the BC Ministry of Environment (BC MOE), and completed by the BC Ministry of Sustainable Resource Management (BC MSRM) and Timberline Forest Inventory Consultants Ltd. (BC MSRM 2001; Timberline Natural Resource Group 2007, 2008). The data were created between 2001 and 2008 for the Lakes Timber Supply Area (TSA), and the Prince George, Fort St. James, and Morice forest districts. The raster-based PEM data were created using the software tools EcoGen (v2) and NetWeaver developer (v3.2). The following sections describe the key data input. Further details can be found in the reports by Timberline Natural Resource Group (2007; 2008).

2.3.2.1 Input Layers

Biogeoclimatic Ecosystem Units and Climate Variations

Input to the model included a BEC unit (zone, subzone, variant) map. The BEC unit map was a “localized” (finer-scale) version of the coarser-scale, core BEC unit map. Localization is typically a pre-requisite for PEM (RIC 1999). The localized BEC unit map indicates the range of climatic zones and characteristics of the area and the range of possible ecosystem units. To refine this information, climate modifiers were added to the model to account for variations within a given BEC unit. Three climate variations were distinguished: average, wetter than average, and drier than average.

Terrain Data and Derivatives

The BEC base polygons were derived from, and used in conjunction with, TRIM polygons. These TRIM data indicate the distribution of surficial materials, landforms, and geomorphological processes. Soil drainage is also classified. Terrain mapping was based on the standard scheme for the classification of surficial materials, landforms, and geomorphological processes in British Columbia (Howes and Kenk 1997).

A georeferenced Digital Elevation Model (DEM) was produced from the elevation information. Information classes derived from the DEM included slope (e.g., level, steep), aspect (warm, cool or neutral), and solar insolence (which considers the shading effect of neighbouring mountains). In addition, the DEM was used to create a soil moisture model using both topographic and hydrologic analyses. Soil moisture is often the most important landscape attribute controlling ecosystem distribution within a given landscape (Timberline Natural Resource Group 2007). The first component needed to model soil moisture is topographic exposure (i.e., whether a given point is a ridge, a slope with a convex shape, a slope with a concave shape, etc.). Topographic exposure was assessed at various spatial scales based on the relative heights of adjacent points (i.e., whether elevations of adjacent points are higher, lower, or unchanged on average). Next, slope and elevation were used to model potential soil moisture based on the total upslope area that would contribute water flow to a given point below. Six soil moisture classes, ranging from very xeric (very dry) to hygric (very wet), were created. These classes were nested within each topographic exposure class to construct a realistic model. Refer to Timberline Natural Resource Group (2008) for further details regarding soil moisture modelling.

When combined into a rule set, these terrain attributes define an "environmental setting" (MacMillan 2005) within which a particular, predictable ecological unit (site series) or combination of ecological units could be expected to occur.

Vegetation Resources Inventory Data

Several attributes from Vegetation Resources Inventory (VRI) data were also selected for input to the PEM. The attributes of general land cover component (treed coniferous, low shrub, herb, non-vegetated, etc.) and species composition (leading and secondary species) were thought to be particularly useful for prediction of forested ecosystems including Douglas-fir (*Pseudotsuga menziesii*) and black spruce (*Picea mariana*) ecosystems, as well as for non-forested ecosystems.

2.3.3 Vegetation Structural Stage

The existing developmental stage of the vegetation within an area can be described using structural stage. Vegetation structural information is an important attribute commonly used to describe the habitat characteristics of vegetated ecosystems (RIC 1998). Structural stages range from un-vegetated units to old-growth forest (Table 2.3-1). A numeric code is provided for each stage, the details of which are provided in the TEM standards (RIC 1998). Structural stage is a required PEM and TEM attribute (RIC 1999).

Table 2.3-1
Ecosystem Mapping Structural Stages

Structural Stage	Structural Stage Code
Sparse/Un-vegetated	1
Herb, Dwarf Shrub	2a, 2b
Shrub	3, 3a, 3b
Young Forest	4
Mature Forest	5-6
Mature-Old Forest	7
Water, Snow/Ice	N/A

The vegetation structural stage information for the footprint and LSA were completed concurrently with TEM. For the RSA, vegetation structural stage data were acquired from the BC MOE, modelled as layer separate from the PEM. The structural stage data were then overlaid on the PEM data to summarize structural stage and site series (or general ecosystem type) for any given location. In some cases, the combination of structural stage and site series was assumed incorrect (e.g., pure polygons of disclimax shrub/herb ecosystems modelled as structural stage 7), likely as a result of differences in spatial resolution and polygon extents. In these cases, the structural stage data were modified to a more likely class. Note also that significant portions of the area were unclassified with respect to structural stage.

2.4 Field Surveys

2.4.1 Field Studies

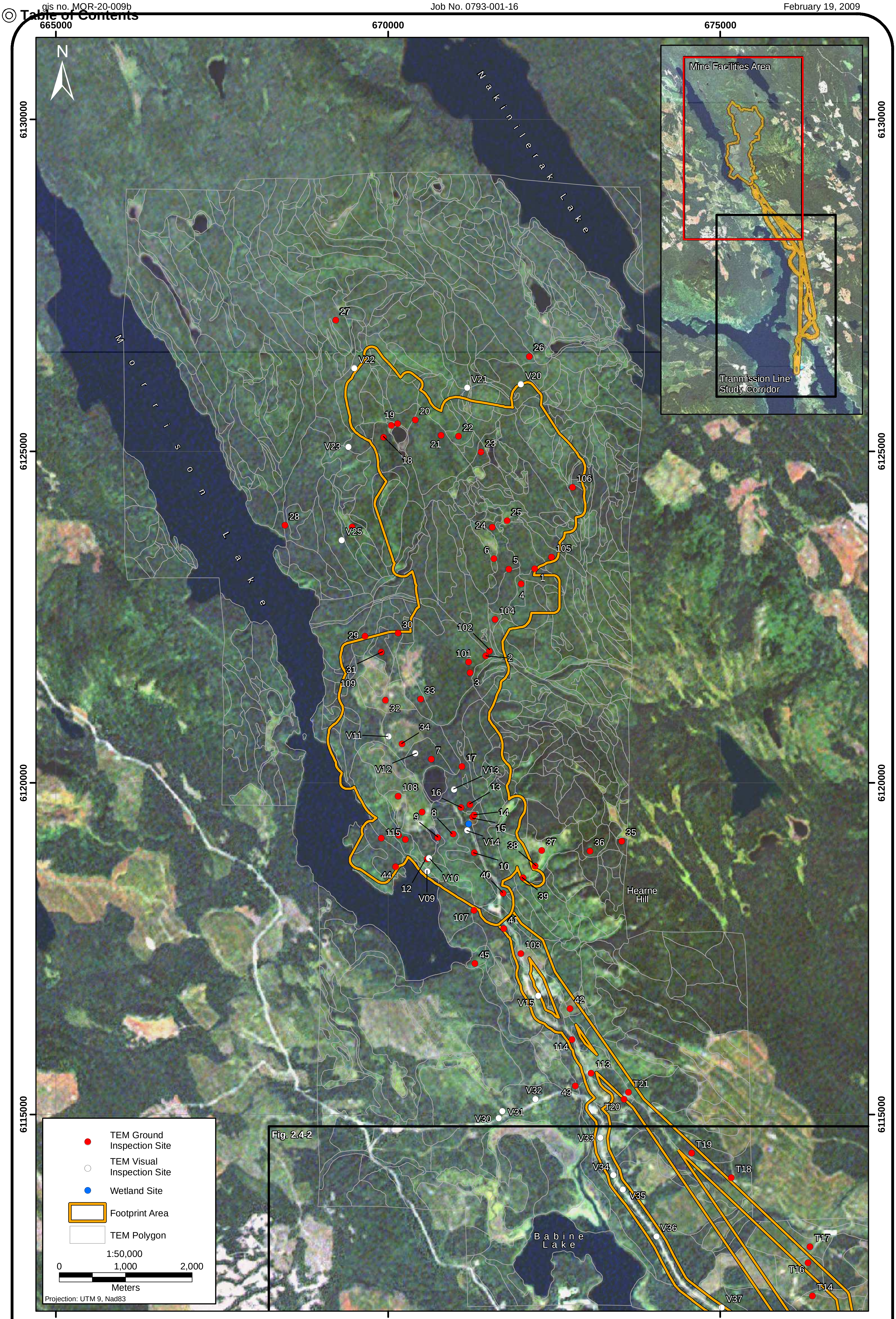
The TEM field investigations and research focused on general characterization of the ecological community structure and diversity to refine the ecosystem map for the footprint area. Particular emphasis was placed on identifying ecosystem units, as well as species and ecosystems of conservation concern. The collection of vegetation data for the baseline studies occurred during September, 2006, and July, 2008. Field teams consisted of a plant ecologist, soil scientist, wildlife biologist and a Babine Lake First Nations assistant. Detailed soils and habitat suitability information was concurrently collected and is discussed in the *Morrison Copper/Gold Project Physiography, Surficial Materials, and Soils Baseline Report* (Rescan 2009b) and the *Morrison Copper/Gold Project Wildlife Habitat Suitability Rating Baseline Report* (Rescan 2009d), respectively. All data were collected in accordance with the *Field Manual for Describing Terrestrial Ecosystems* (BC MELP and BC MOF 1998) and the *Field Guide to Site Identification and Interpretation for the Prince Rupert Forest District* (Banner et al. 1993). Field data were entered into the provincial data entry program VENUS (version 5.0).

Plot locations were established in areas most likely to be affected by Project development and are illustrative of the ecosystem types present within the proposed Project area (figures 2.4-1 and 2.4-2). The TEM field plots were in areas characteristic of a single terrain and (where feasible) ecosystem unit. Site locations were selected based on representative slope positions, landform types, soil texture, soil drainage, species composition, stand structure and physiognomy according to the provincial standards (RIC 1998). At each site, Ground Inspection Forms (GIF) were used to record the following attributes: date, geographic location, slope, aspect, elevation, relative slope position, soil drainage, plant species and ecosystem unit, structural stage and crown closure (Appendix 3). Percent cover was estimated for the dominant/indicator plants and for the tree, shrub, herb and moss/lichen layers present in the plot. In addition to these rigorous "ground" inspections, a number of "visual" observations were also conducted. Fewer details were collected during these visual surveys, which were usually conducted while travelling between ground inspection plots, particularly at unique or transitional sites. Both types of survey data were used to refine the delineation of ecosystem units for TEM.

2.5 Plants of Interest

2.5.1 Listed Plants

Prior to the commencement of field work, an online search was conducted to identify rare plants potentially occurring within the footprint or LSA. The following databases were utilized: the BC Conservation Data Centre (BC CDC), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and the Species at Risk Registry (BC CDC 2008; Environment Canada 2008). Query parameters for the BC CDC search were set to identify all red- and blue-listed plant species in the Nadina Forest District. The resulting list of potentially occurring threatened, extirpated, or endangered plants (Appendix 4) was used in a presence/not-detected level of inventory to document any such plants within the Project area.



Morrison Copper/Gold Project Terrestrial Ecosystem Mapping (TEM) Inspection Sites in the Mine Facilities Area

FIGURE 2.4-1

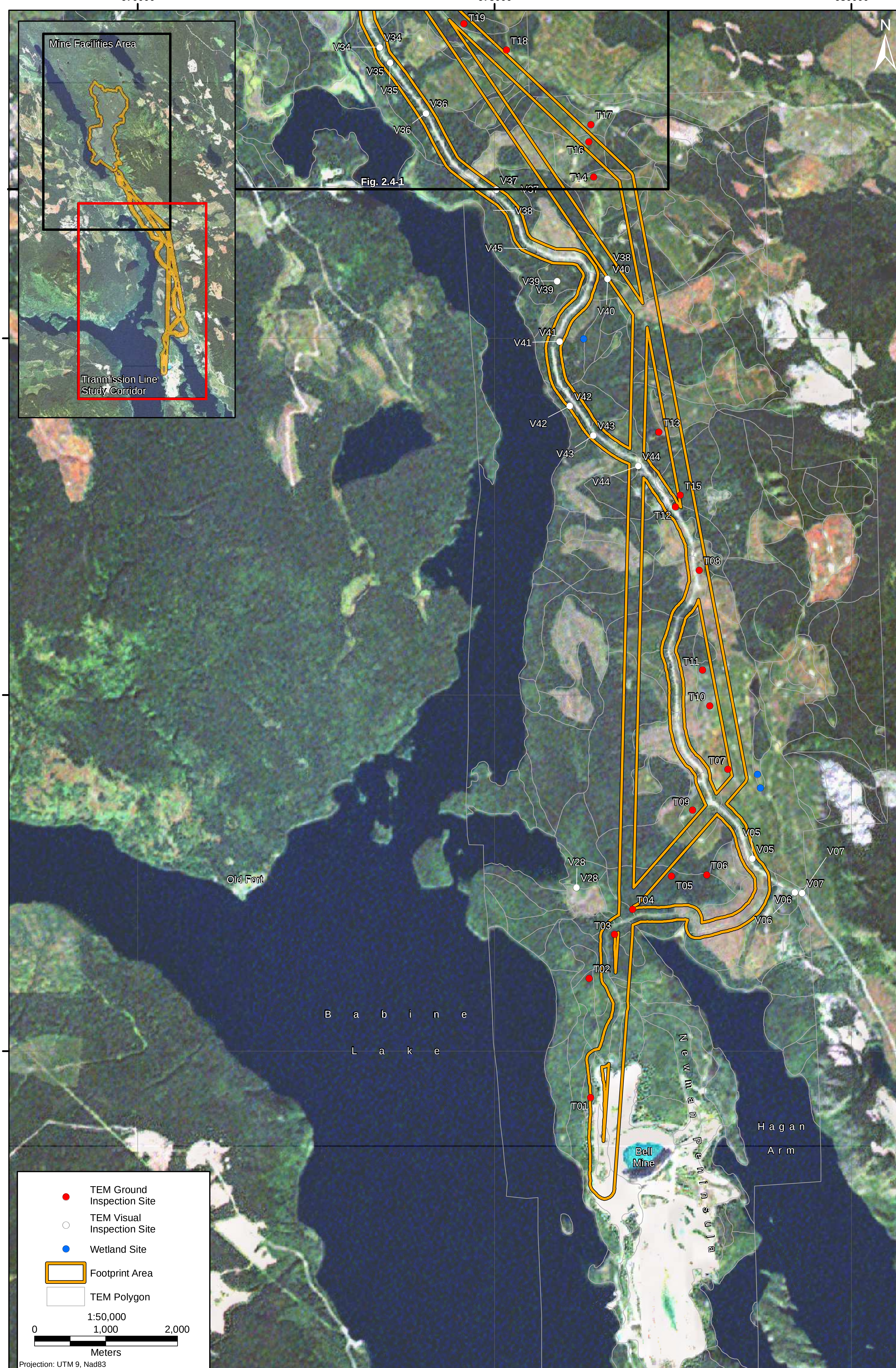


FIGURE 2.4-2

Morrison Copper/Gold Project Terrestrial Ecosystem Mapping (TEM) Inspection Sites in the Transmission Line Study Corridor

2.5.2 Country Food Plants

Country foods are animals, plants, or fungi used by people for medicinal or nutritional purposes that are harvested through hunting, gathering, or fishing. Interviews with local community members were conducted to determine, among other things, what country foods are collected from the Project area. This report focuses on the vegetation component of country foods. Additional information is described in the *Morrison Copper/Gold Project Country Foods Baseline Report* (Rescan 2009a). All of the plant species identified as being of significant use to the community were cross-referenced with plant species lists developed during field surveys conducted for the ecosystem mapping and vegetation studies. Additionally, regional field guides (MacKinnon, DeLong, and Meidinger 1990; Banner et al. 1993) were used to identify the ecosystems within which these plants most commonly occur. This information was compared to ecosystems present in the footprint area to determine the relative abundance of each country food plant species within the footprint area.

2.5.3 Invasive Plant Species

A review of invasive plants and nuisance weeds as defined by the *British Columbia Weed Control Act* was compiled prior to the commencement of fieldwork and compared with 2006 and 2008 baseline field results. A presence/not-detected level of inventory was then used to document invasive plants.

2.6 Ecosystems of Interest

Certain ecosystems were given special attention because of their conservation status and/or sensitivity to development. These ecosystems were collectively called "ecosystems of interest." Two types of ecosystems of interest were identified in the Project area: listed ecological communities and sensitive ecosystems.

2.6.1 Listed Ecosystems

A search of the online databases maintained by the BC CDC was conducted, and a list of rare ecological communities potentially occurring in the area was compiled (Appendix 5). A presence/not-detected level of inventory was then used to document and map these ecological communities of special concern.

2.6.2 Sensitive Ecosystems

Sensitive ecosystems as defined by the BC MOE Sensitive Ecosystems Inventory are generally characterized as ecosystems that are fragile and/or rare (BC MOE 2007b). For this report, sensitive ecosystems refer to fragile ecosystems only, as rare ecosystems have been addressed separately. Ecosystem fragility refers to the sensitivity of an ecosystem with respect to disturbance (McPhee et al. 2000). Sensitive ecosystems vary throughout the province but generally include wetlands, riparian areas, natural meadows, and certain forest types. For this Project, sensitive ecosystems include riparian, wetland, and transitional areas.

2.6.2.1 Riparian Ecosystems

Riparian forests serve a number of important ecological functions, such as providing course woody debris for fish habitat and increasing bank stability to reduce erosion (Banner and MacKenzie 1998). Riparian ecosystems are adjacent to streams, lakes, ponds, and wetlands and differ from the uplands because of their high levels of soil moisture and soil nutrients, frequent flooding, and unique assemblage of plant and animal communities (Banner and MacKenzie 1998).

In many regions of southern British Columbia, the Riparian Areas Regulation Act enacted under the *Fish Protection Act* (BC MOE 2007a) mandates a buffer of 30 m on either side of a waterbody within which industrial, commercial, and residential developments and activities are subject to special constraints. For forestry-related activities throughout the province, the width of riparian buffers ranges from 10 m to 100 m, depending on the characteristics of the waterbody (BC MOFR 2004). For example, streams are rated from S1 to S6 according to their size (smallest to largest, respectively) and whether or not they are fish-bearing; streams with class S1 require a buffer zone of 70 m to 100 m, while streams with a class of S6 require a 20 m buffer. Within the Project area, most streams are class S3 or smaller. Given that the associated riparian buffer width for an S3 stream is 40 m, and that 40 m is also the average of the riparian buffer width needed for wetlands, a 40 m buffer was applied to all sides of streams, lakes, and wetlands (as delineated on the provincial TRIM data) within the footprint area. This chosen width exceeds the 30 m buffer width required in the Riparian Areas Regulation.

2.6.2.2 Wetland and Transitional Ecosystems

Wetland and transitional ecosystems include true wetlands as well as ecosystems that are transitional to upland ecosystems such as forested swamps, wet meadows, shrub-carr, and seepage ecosystems (MacKenzie and Moran 1998; Table 2.6-1). Wetland and transitional ecosystems provide important habitat for waterfowl and other wildlife and contribute to the quantity and quality of surface and groundwater (Ducks Unlimited Canada 1998; MacKenzie and Moran 1998). TEM, PEM, and TRIM data were used to identify wetland and transitional ecosystems within the LSA and RSA. Field data from 2006 and 2008 were used to refine the ecosystem mapping characterization of these ecosystems.

Table 2.6-1
Wetland and Transitional Ecosystem Legend

Ecosystem	Ecosystem Unit / Map Code	General Ecosystem Type	Sensitive Ecosystem Classification
Alpine wetland	AW	Wetland	Wetland
Cow-parsnip meadow	CP	Wetter Shrub/Herb	Transitional
Riparian shrub	RS	Wetter Shrub/Herb	Transitional
Non-treed bog/marsh	31|32	Wetland	Wetland
Organic sedge fen	FE	Wetland Shrub/Herb	Wetland
Organic treed fen	OF	Wetter Forest	Transitional
Organic shrub fen	OS	Wetland Shrub/Herb	Wetland
Swamp forest	SBSmc2 - 12	Wetter Forest	Transitional
Shrub-carr	CU	Wetter Shrub/Herb	Transitional
Low bench floodplain	LU	Wetter Shrub/Herb	Transitional
Wet meadow	ME	Wetter Shrub/Herb	Transitional

2.7 Metal Concentrations in Plant Tissue

Tracking metal concentrations in plant tissues is a requirement of the mine permit application and is used to guide reclamation planning and end land use objectives (BC Ministry of Energy and Mines 1998). Future plant tissue metal concentrations may be compared to baseline values to assess any changes. Plant tissue samples were collected to monitor metal concentrations within the footprint area (Figures 2.7-1 and 2.7-2).

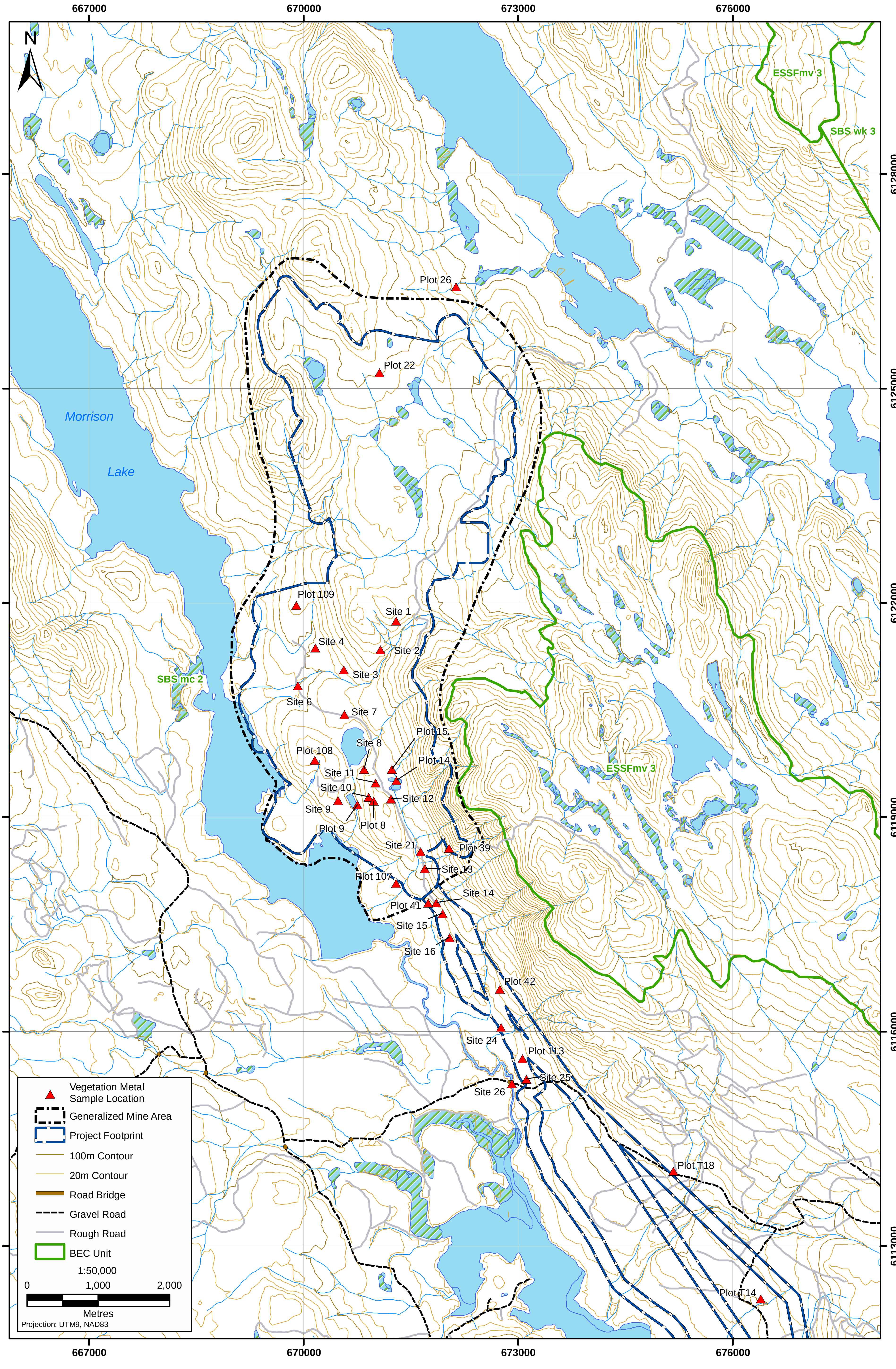


FIGURE 2.7-1

Morrison Copper/Gold Project Metal Sampling Site Locations in the Mine Facilities Area

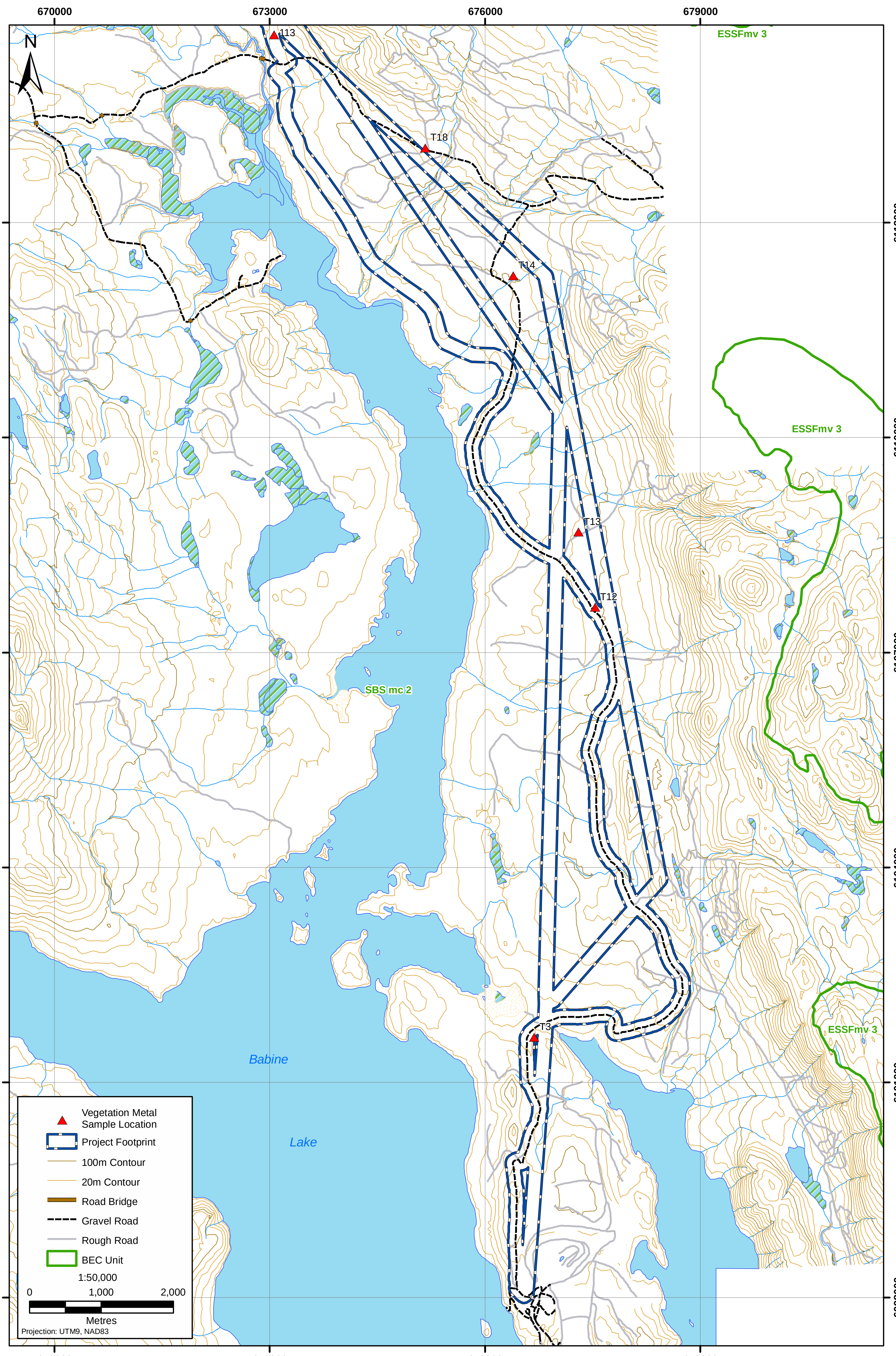


FIGURE 2.7-2

Morrison Copper/Gold Project Metal Sampling Site Locations in the Transmission Line Study Corridor

To assess spatial differences in metal concentrations within the footprint area, samples collected within the proposed MFA were compared to those collected within the TLSC. Separation of these samples will allow for future effects monitoring from potential changes associated with each type of development.

Plant species commonly found throughout the study area and likely to be a food source for wildlife or people were targeted for collection. The same plant species were collected among sample plots wherever possible; however, in some cases, site variability necessitated the collection of a different species. The above-ground portion of herbaceous plants and the new growth of woody shrubs were sampled. Dirt and roots were removed before samples were placed into a plastic sampling bag. Samples were sent to ALS Laboratory Group in Vancouver, BC, for analysis. The list of metals analyzed and their detection limits is shown in Table 2.7-1.

Table 2.7-1
Plant Tissue Detection Limits for Total Metals for 2006, 2007, and 2008

Metal	2006 - Dry Weight Detection Limit (mg/kg dry weight)	2006 - Wet Weight Detection Limit (mg/kg wet weight)	2007 - Wet Weight Detection Limit (mg/kg wet weight)	2008 - Dry Weight Detection Limit (mg/kg dry weight)
Aluminum	10	4	2	2
Antimony	0.05	0.02	0.01	0.01
Arsenic	0.05	0.02	0.01	0.01
Barium	0.05	0.02	0.01	0.01
Beryllium	0.3	0.2	0.1	0.1
Bismuth	0.3	0.2	0.03	0.03
Cadmium	0.03	0.01	0.005	0.005
Calcium	10	4	2	2
Chromium	0.5	0.2	0.1	0.1
Cobalt	0.1	0.04	0.02	0.02
Copper	0.05	0.02	0.01	0.01
Iron	N/A	N/A	0.20	0.2
Lead	0.1	0.04	0.02	0.02
Lithium	0.5	0.2	0.1	0.1
Magnesium	3	2	1.0	1
Manganese	0.05	0.02	0.01	0.01
Mercury	0.005	0.001	0.001	0.001
Molybdenum	0.05	0.02	0.01	0.01
Nickel	0.5	0.2	0.1	0.1
Potassium	N/A	N/A	20	20
Selenium	1	0.4	0.2	0.2
Sodium	N/A	N/A	20	20
Strontium	0.05	0.02	0.01	0.01
Thallium	0.03	0.02	0.01	0.01
Tin	0.2	0.1	0.05	0.05
Titanium	N/A	N/A	0.1	0.1
Uranium	0.01	0.004	0.002	0.002
Vanadium	0.5	0.2	0.1	0.1
Zinc	0.5	0.2	0.1	0.1

3. Results and Discussion

The Project is on the Nechako Plateau within the Intermontane Belt of central British Columbia (Simpson 2007). This area is characterized by a northern interior continental climate of moist and cold conditions. The broad-scale BEC units and the finer-scale general ecosystem types and vegetation structural stages are described for the RSA, LSA, and footprint area in sections 3.1 to 3.3, respectively.

3.1 Regional Study Area

There are four BEC units within the RSA. Low to mid elevations are either in the SBSmc2 (92,530 ha) or the SBSwk3 unit (6,552 ha). Higher elevations above the Sub-boreal Spruce (SBS) zone are either in the ESSFmv3 (7,227 ha) or the ESSFmc variant (1,706).

3.1.1 Biogeoclimatic Ecosystem Classification Units

3.1.1.1 The Sub-boreal Spruce Zone

The SBS zone occurs on forested, mid-elevations (500 m to 1,350 m) of the Nechako Plateau and in some areas of the western and northwestern Hazelton and Skeena mountains (Banner et al. 1993). This zone is characterized by a continental climate that results in cold, snowy winters and warm, moist summers. Mean annual temperatures range from 0.7°C to 3.6°C and mean annual precipitation levels range from 440 mm to 724 mm. The SBS zone is typically dominated by coniferous forests of hybrid spruce (*Picea glauca* x *engelmannii*), lodgepole pine (*Pinus contorta*) and subalpine fir (*Abies lasiocarpa*). This zone contains some of British Columbia's largest rivers including the Skeena, Bulkley, Fraser, Babine, and Nechako rivers as well as several large lakes, including Stuart, Francois, Burns, Trembleur, and the Nation lakes (Ketcheson et al. 1991; Banner et al. 1993; BC MOF 1998b).

Sub-boreal Spruce Moist Cold Subzone - Babine Variant

The SBSmc2 BEC unit is at mid elevations of the Skeena Mountains, the Nechako Plateau, and the Hazelton Mountains. Mean annual precipitation ranges from 440 mm to 650 mm. The SBSmc2 is the primary timber-producing unit in the Prince Rupert forest region (Banner et al. 1993). The vegetation of the SBSmc2 is distinguishable from other SBS BEC units by a sparse herb and shrub layer combined with a well-developed feathermoss (*Pleurozium schreberi*) layer on zonal sites (Banner et al. 1993). Common species in this unit include black huckleberry (*Vaccinium membranaceum*), thimbleberry (*Rubus parviflorus*), and bunchberry (*Cornus canadensis*). Riparian shrubs and herbs are abundant throughout the SBSmc2 and provide valuable forage and habitat for small mammals (Banner et al. 1993).

Sub-Boreal Spruce Wet Cool Subzone - Takla Variant

The SBSwk3 is limited to areas east of Babine Lake in the main and side drainages of the valley occupied by Takla Lake and the Driftwood River, as far south as Trembleur Lake, and as a far north as the Sustut River. Compared to the SBSmc2, the SBSwk3 is generally wetter, and has less prickly rose in the shrub layer and more oak fern in the herb layer on mesic sites. Stand-replacing disturbances are of low frequency; thus, forested areas are often climax forests dominated by hybrid white spruce and subalpine fir. Lodgepole pine is common on sites drier than mesic. Black spruce occurs in wetlands and with lodgepole pine on gently sloping upland sites with a cool aspect. Homogeneous stands of trembling aspen occur primarily along the shores of Takla Lake. Black cottonwood occurs along streams and rivers and is often associated with hybrid white spruce.

3.1.1.2 The Engelmann Spruce Subalpine Fir Zone

The Engelmann Spruce Subalpine Fir (ESSF) zone covers subalpine areas in the interior portion of the southern Prince Rupert forest region (MacKinnon, DeLong, and Meidinger 1990; Banner et al. 1993). The ESSF occurs on high elevation peaks, plateaus, and ridges of the Nechako Plateau, the eastern slopes of the Coast Mountain range and throughout the Hazelton Mountains and most of the Skeena Mountains. It is characterized by a cold, moist continental climate. Mean annual temperatures range from -2°C to +2°C. Mean annual precipitation varies within the zone; drier areas typically receive between 400 and 500 mm while wetter areas receive as much as 2,200 mm, 50% to 70% of which occurs as snow. The snowpack generally remains for five to seven months of the year (BC MOF 1998a). In the mountainous areas of the zone with high snowfall, avalanche tracks are very common and have a unique vegetative layer. Avalanche tracks typically include a combination of Sitka alder (*Alnus crispa* ssp. *sinuata*), arrow-leaved groundsel (*Senecio triangularis*), Indian hellebore (*Veratrum viride*), cow-parsnip (*Heracleum lanatum*), lady fern (*Athyrium filix-femina*), western meadowrue (*Thalictrum occidentale*), stinging nettle (*Urtica dioica*), and sedge species (*Carex* spp.) (Coupé, Stewart, and Wikeem 1991). The subalpine areas not influenced by avalanche disturbance comprise parkland, heath, meadow, and grassland vegetation combined with tree islands. Lower elevations are typically forested and comprise spruce and subalpine forest stands.

Engelmann Spruce Subalpine Fir Moist Very Cold Subzone - Omineca Variant

The distribution of the ESSFmv3 variant is limited to a few high elevation areas east of Babine Lake (MacKinnon, DeLong, and Meidinger 1990), and occurs within the LSA on Hearne Hill at approximately 1,100 m elevation (slightly higher on the warm southwest facing slopes). The mean annual precipitation ranges from 202 mm to 316 mm and the mean annual temperature is 0.4°C. The ESSFmv3 is floristically distinguishable from adjoining BEC units because of the presence of white-flowered rhododendron (*Rhododendron albiflorum*) combined with a lesser presence of black twinberry, highbush-cranberry, and prickly rose (*Rosa acicularis*) on mesic sites (MacKinnon, DeLong, and Meidinger 1990).

Engelmann Spruce Subalpine Fir Moist Cold Subzone

The ESSFmc BEC unit is characterized by dry summers and light snowpack relative to the wet subzones (Banner et al. 1993). Ecosystems are characterized by an ericaceous shrub layer and a sparse herb layer (Coupé, Stewart, and Wikeem 1991). It is distinguished by the presence of knight's plume (*Ptilium crista-castrensis*), bunchberry (*Cornus Canadensis*), and heart-leaved arnica (*Arnica cordifolia*).

3.1.2 Mapped General Ecosystem Types

Mesic forests are the dominant general ecosystem type within the RSA, accounting for 72% in total, and at least 56% of each BEC unit (Figure 3.1-1; 3.1-2 (map pocket)). Wetter forests are the second most dominant vegetated ecosystem type, accounting for 7% of the area. However, within the ESSFmc BEC unit specifically, drier forests are more abundant than wetter forests. Details of the general ecosystem types and their corresponding site series/ecosystem units within the RSA are provided in Appendix 6.

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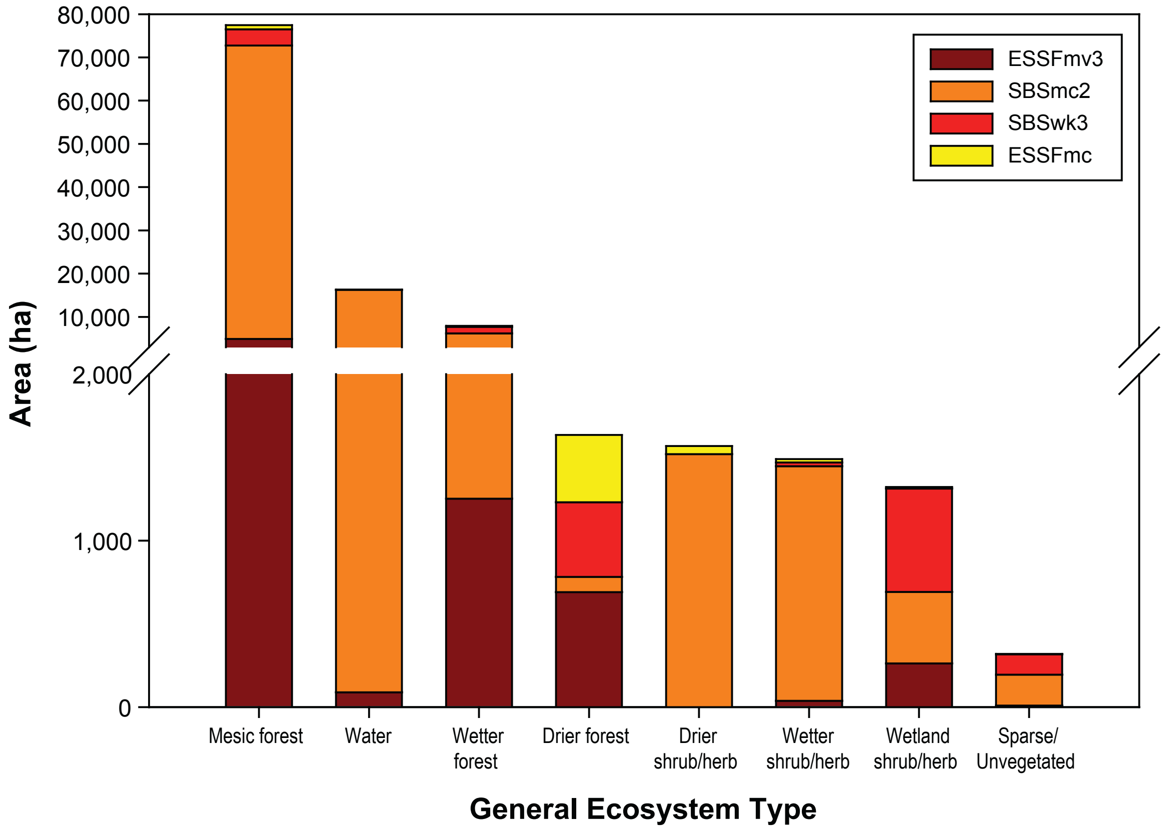


Morrison Copper/Gold Project
Distribution of General Ecosystem Types in the Regional Study Area

FIGURE 3.1-1

3.1.3 Vegetation Structural Stage

The RSA is predominately composed of mature forests (34,730 ha, or 32%). The second most dominant structural stage is old/mature (28,971 ha, or 27%), and the third most common is shrub (21,180 ha, or 20%; Figure 3.1-3; 3.1-4 (map pocket)). The distribution of structural stages within the RSA is listed in Appendix 7.

3.2 Local Study Area

3.2.1 Biogeoclimatic Ecosystem Classification Units

The LSA covers 18,660 ha and contains both the SBSmc2 and the ESSFmv3 BEC units. The SBSmc2 covers 18,485 ha (99%) and the ESSFmv3 covers 375 ha (<1%) of the LSA.

3.2.2 Mapped General Ecosystem Types

More than 60% of the total area within the LSA is forested, the majority of which is mesic forest (figures 3.2-1 and 3.2-2; map pockets). Mesic forest is the dominant ecosystem type in the SBSmc2, accounting for 70% of the vegetated ecosystems in this unit (Figure 3.2-3). Water is the second most dominant general ecosystem type in the SBSmc2; however, wetter forests are the second most dominant out of the forested ecosystems,. Drier forest is the most common ecosystem in the ESSFmv3, followed closely by wetter forests and mesic forests. Details of the general ecosystem types and their corresponding site series/ecosystem units within the LSA are summarized in Appendix 8. Full details of the distribution of all TEM polygons and associated data are listed in Appendix 9.

3.2.3 Vegetation Structural Stage

The dominant vegetation structural stage within the LSA is mature forest, accounting for 54% of the vegetated areas. Shrubs account for an additional 20% and young forests account for most of the remaining vegetation (figures 3.2-4 and 3.2-5; map pockets). Herb, dwarf shrub, and old forests, collectively, are present in less than 1% of the LSA (Figure 3.2-6). The distribution of structural stages within the LSA is listed in Appendix 10.

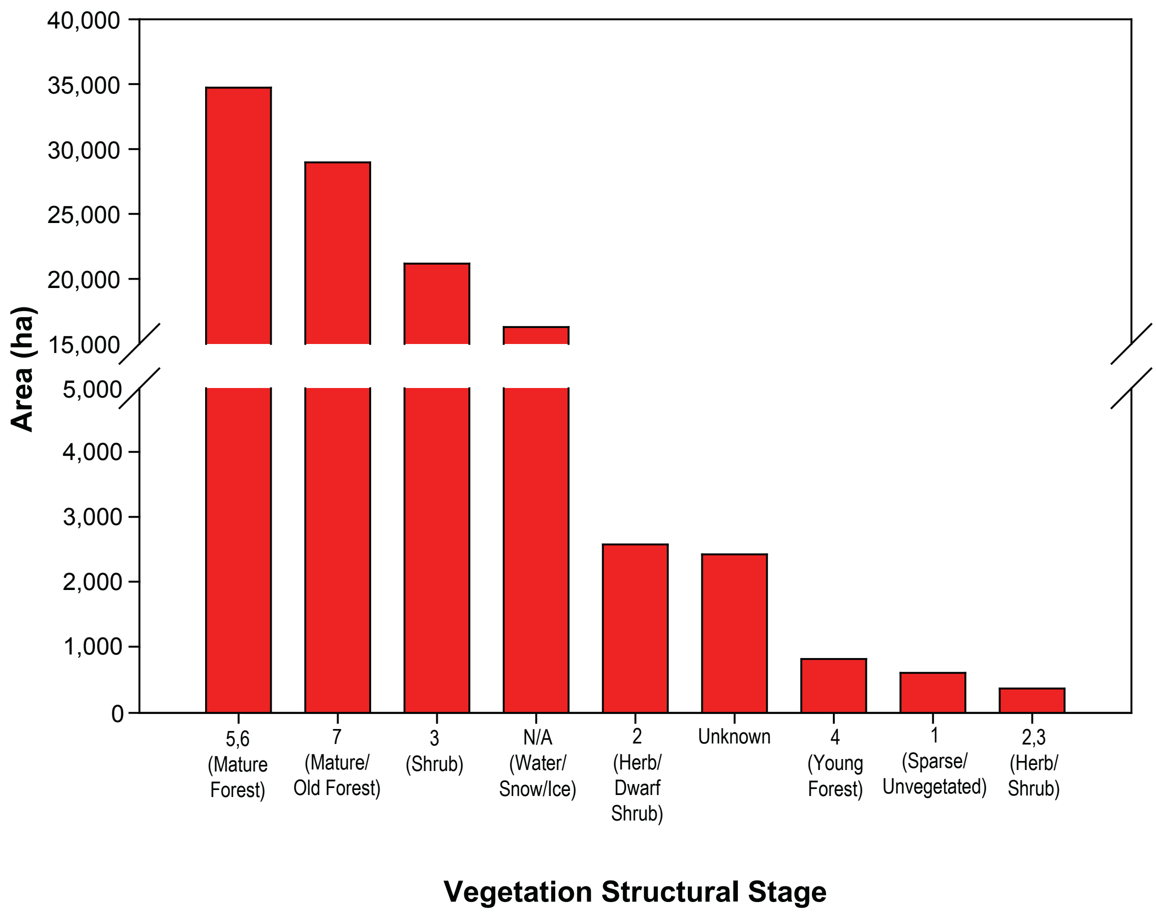
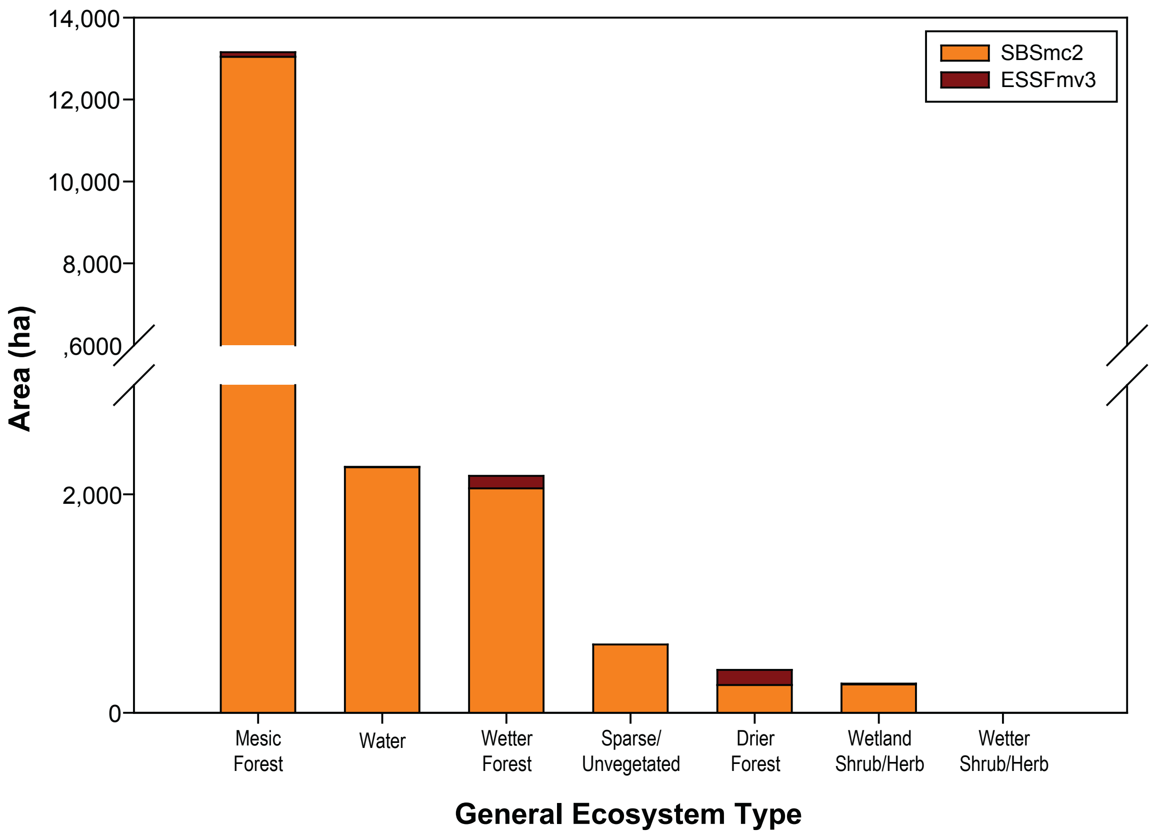


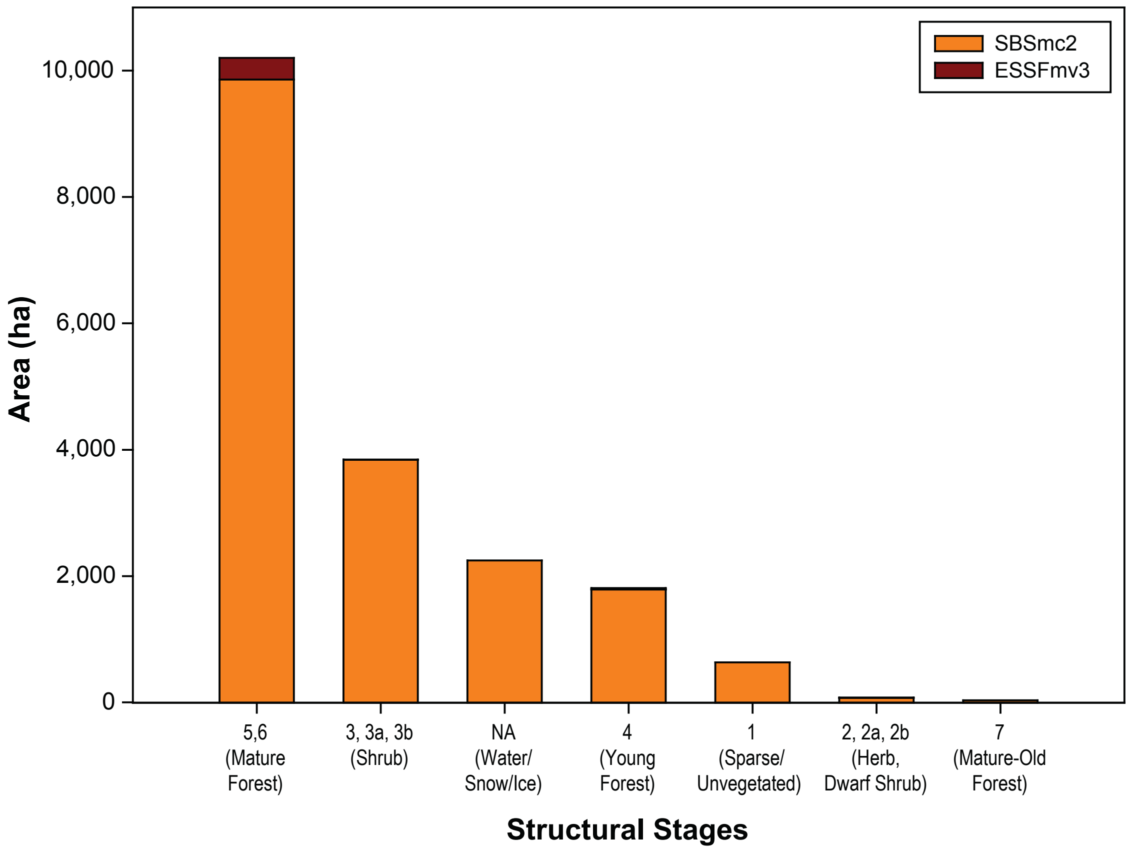
FIGURE 3.1-3

Morrison Copper/Gold Project Vegetation Strucutral Stage in the Regional Study Area



Morrison Copper/Gold Project
Distribution of General Ecosystem Type in the Local Study Area

FIGURE 3.2-3



Morrison Copper/Gold Project
Distribution of Vegetation Structural Stages in the Local Study Area

FIGURE 3.2-6

Rescan™

3.3 Footprint Area

3.3.1 Biogeoclimatic Ecosystem Classification Units

The footprint area, covering 3,005 ha, is predominantly within the SBSmc2 biogeoclimatic unit, with a small portion within the ESSFmv3 unit.

3.3.2 General Ecosystem Types Identified in the Field

Six general ecosystem types were identified within the 107 ground and visual sites surveyed in the field. The majority (68%) of field plots were within mesic forests (Appendix 11). Wetter forests were the next most common general ecosystem type surveyed, accounting for 22% of field plots. Drier forests and wetlands each made up nearly 4% of the field plots. One field plot was identified as a drier shrub/herb ecosystem, and one as a wetter shrub/herb ecosystem; these two sites, along with one wetland site and one wetter forest site, were documented as unique ecosystems, which have yet to be fully described (Banner et al. 1993). The ecological characteristics and typical vegetation communities for each of these ecosystems were documented and are summarized in (Appendix 1 - Table A1).

Mapped General Ecosystem Types

The distribution of the general ecosystem types and their corresponding site series/ecosystem units within the footprint area are listed in Appendix 12.

3.3.2.1 Mine Facilities Area

Mesic forests cover 1,600 ha (nearly 90%) of the MFA, which is approximately 84% of the total footprint area (figures 3.2-1 and 3.2-2; map pockets; Figure 3.3-1). Mesic forests are characterized by intermediate soil moisture and nutrient regimes that occur on mid-slope positions, and moderately deep to deep soils with unrestricted drainage as described in Banner et al. (1993). Wetter forests cover 118 ha (approximately 4%) of the MFA and approximately 1% of the footprint area. Drier forests, wetland shrub/herb, water and sparse/un-vegetated ecosystems each account for <1% of the MFA.

3.3.2.2 Transmission Line Study Corridor

Mesic forests are also the dominant ecosystem in the TLSC, covering 924 ha (76%; Figure 3.3-1). Wetter forests are the second most common ecosystem type and account for 16% of the TLSC. The remaining general ecosystem types each account for <1% of the TLSC.

3.3.3 Vegetation Structural Stage

Mature forests are the dominant vegetation structural stage in the footprint area, accounting for approximately 47% of the vegetated area (figures 3.2-4 and 3.2-5; map pockets; Figure 3.3-2). The MFA contains more mature forest than the TLSC. The TLSC contains relatively more shrubs than the MFA, although shrubs are the second most common structural stage for both areas, accounting for 20% of the vegetated areas in total. The distribution of structural stages within the footprint area is listed in Appendix 13.

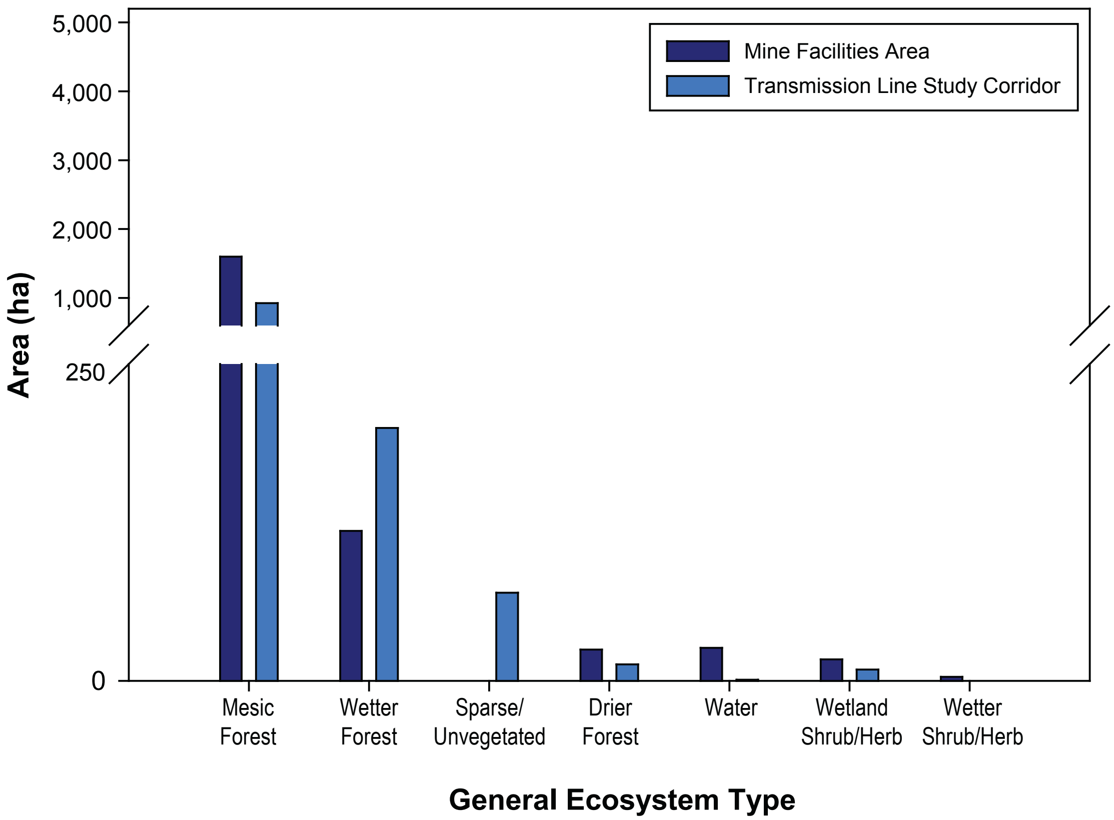
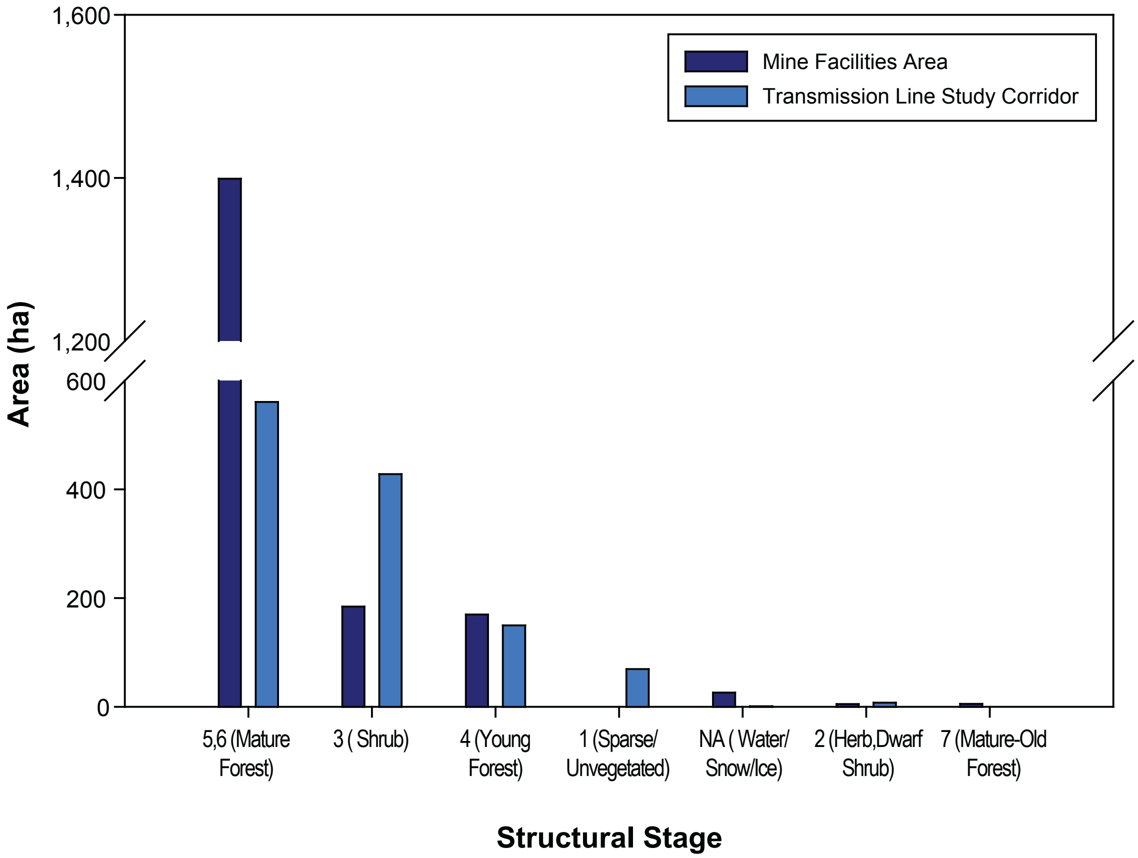


FIGURE 3.3-1

Morrison Copper/Gold Project Distribution of General Ecosystem Type in the Footprint Area



Morrison Copper/Gold Project
Distribution of Vegetation Structural Stages in the Footprint Area

FIGURE 3.3-2

3.4 Plant Species of Interest

3.4.1 Species Richness

A total of 188 plant species (including those identified to genus level only), belonging to 49 different families, were identified within the proposed Project area. Forbs were the most dominant plant type and accounted for 69 of the 188 plant species. Deciduous shrubs are the second most dominant plant type and account for 33 species. The complete list of species and plant types is summarized in Appendix 14.

3.4.2 Listed Plant Species

The BC CDC currently tracks eight vascular plants (seven forbs and one tree species) within the Nadina Forest District (Appendix 4). All eight species are provincially blue-listed. Two of these species, whitebark pine (*Pinus albicaulis*) and western Jacob's ladder (*Polemonium occidentale* ssp. *occidentale*), have good potential to occur within the Project area based on the BEC units present. However, field studies did not identify any rare plants tracked by the BC CDC.

3.4.3 Country Food Plants

The following plant species were identified during interviews as country food plants within the region (Rescan 2009a):

- blueberry (*Vaccinium* spp.)
- highbush-cranberry (*Viburnum edule*)
- black huckleberry (*Vaccinium membranaceum*)
- raspberry (*Rubus* spp.)
- soapberry (*Shepherdia canadensis*)

Black huckleberry and highbush-cranberry are characteristically abundant in many of the ecosystem types within the footprint area and are likely the most common of the country food plants in the area (Table 3.4-1). Field studies indicate that raspberry is locally abundant on disturbed sites. Blueberry and soapberry are not abundant within the footprint area. Blueberry predominantly occurs in the black spruce-pine-feathermoss 03 site series and soapberry occurs in the pine-kinnikinnick-cladonia 02 site series of the SBSmc2. Neither of these ecosystems are common in the footprint area.

Table 3.4-1
Distribution of Country Food Plants in the Footprint Area

Species	Ecosystems within which Species are Common or Abundant*	Number of Field Plots with Country Food Plants
Black Huckleberry	SBSmc2/01, SBSmc2/02, SBSmc2/07, ESSFmv3/01, ESSFmv3/02, ESSFmv3/03, ESSFmv3/04, ESSFmv3/08	36
Blueberry	SBSmc2/03,	16
Highbush-cranberry	SBSmc2/05	56
Raspberry	ESSFmv3/07	35
Soapberry	SBSmc2/02, ESSFmv3/03	13

***Ecosystems are defined in Appendix 2**

3.4.4 Invasive Plants

Two invasive plant species, western water hemlock (*Cicuta douglasii*) and common horsetail (*Equisetum arvense*), were identified within the LSA (Figure 3.4-1). Western water hemlock was documented at one site in the LSA. This species is a highly toxic, native member of the parsnip family that typically grows in moist areas near streams and wetlands (BC MAL 2002; Canadian Biodiversity Information Facility 2008). The roots, stem, and leaves of this plant are poisonous to all types of livestock and to humans (BC MAL 2002; Cranston, Ralph, and Wikeem 2002). Common horsetail was documented at twelve sites within the Project area. This species is native to BC and is defined by the BC Ministry of Agriculture and Lands (BC MAL) as a "nuisance weed," but is not regulated by the *BC Weed Control Act* (Cranston, Ralph, and Wikeem 2002). Common horsetail is a valuable food source for grizzly bear and waterfowl (Hope et al. 1991). Horsetail reproduces vegetatively and through the production of spores, which are often short-lived; it is primarily dispersed by water, spores, and vegetative fragments but can also be spread by humans, animals, and machinery. Common horsetail is widespread throughout the province (BC MAL 2002).

3.5 Ecosystems of Interest

3.5.1 Listed Ecosystems

The BC CDC currently tracks 35 ecological communities within the Nadina Forest District (Appendix 5). Twenty-seven of these communities are blue-listed and eight are red-listed. Twelve of these ecosystems (including six wetland ecosystems) have the potential to occur within the RSA based on the BEC units present. Four of these ecosystems were mapped within the LSA or RSA using vegetation field studies, TEM, or PEM (Figure 3.5-1). One blue-listed wetland ecosystem was identified during the wetland field program and is discussed in the Wetlands baseline report (Rescan 2009c).

Field studies identified one red-listed ecosystem, Saskatoon/slender wheatgrass (SBSmc2 81) (Amelanchier alnifolia / Elymus trachycaulus), in the footprint area. The PEM identified this dry shrub/herb ecosystem, as well as another red-listed dry shrub/herb ecosystem, Sandberg's bluegrass - slender wheatgrass (SBSmc2 82; *Poa secunda* ssp. *secunda - Elymus trachycaulus*), in scattered locations throughout the LSA and RSA. According to the PEM, SBSmc2 81 covers 18 ha and 75 ha in the LSA and RSA, respectively, while SBSmc2 82 covers 216 ha and 1,493 ha in the LSA and RSA, respectively (Appendix 6). Note that the PEM labelled all dry grassland/scrubland ecosystems in the region, regardless of BEC unit, as SBSmc2 81 or 82.

Two other listed ecosystems were identified by the PEM within the RSA: lodgepole pine/black huckleberry/reindeer lichens (SBSwk3 02; Pinus contorta/Vaccinium membranaceum/Cladina spp.;) and Douglas-fir - hybrid white spruce/thimbleberry (SBSwk3 03; *Pseudotsuga menziesii - Picea engelmannii x glauca*/*Rubus parviflorus*;). Together, these drier forest ecosystems account for 96 ha (<1%) of the RSA (Appendix 6).

The TEM does not show any red- or blue-listed ecosystems occurring in the footprint or LSA. The discrepancy within the footprint/LSA is due to differences in mapping methodology. The true extent of these listed ecosystems is likely intermediate between the values estimated by the TEM and PEM methodologies.

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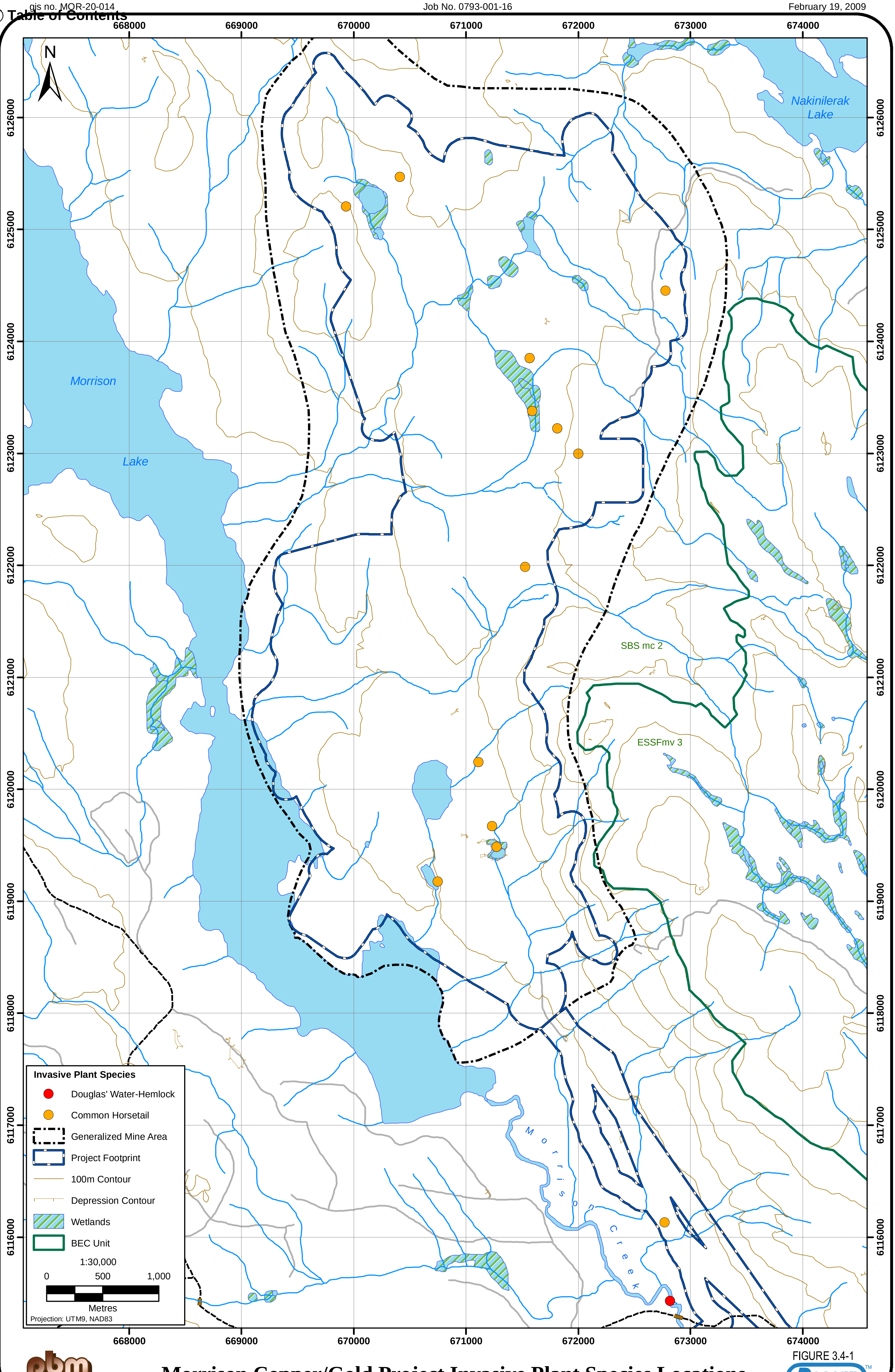

FIGURE 3.4-1

Morrison Copper/Gold Project Invasive Plant Species Locations

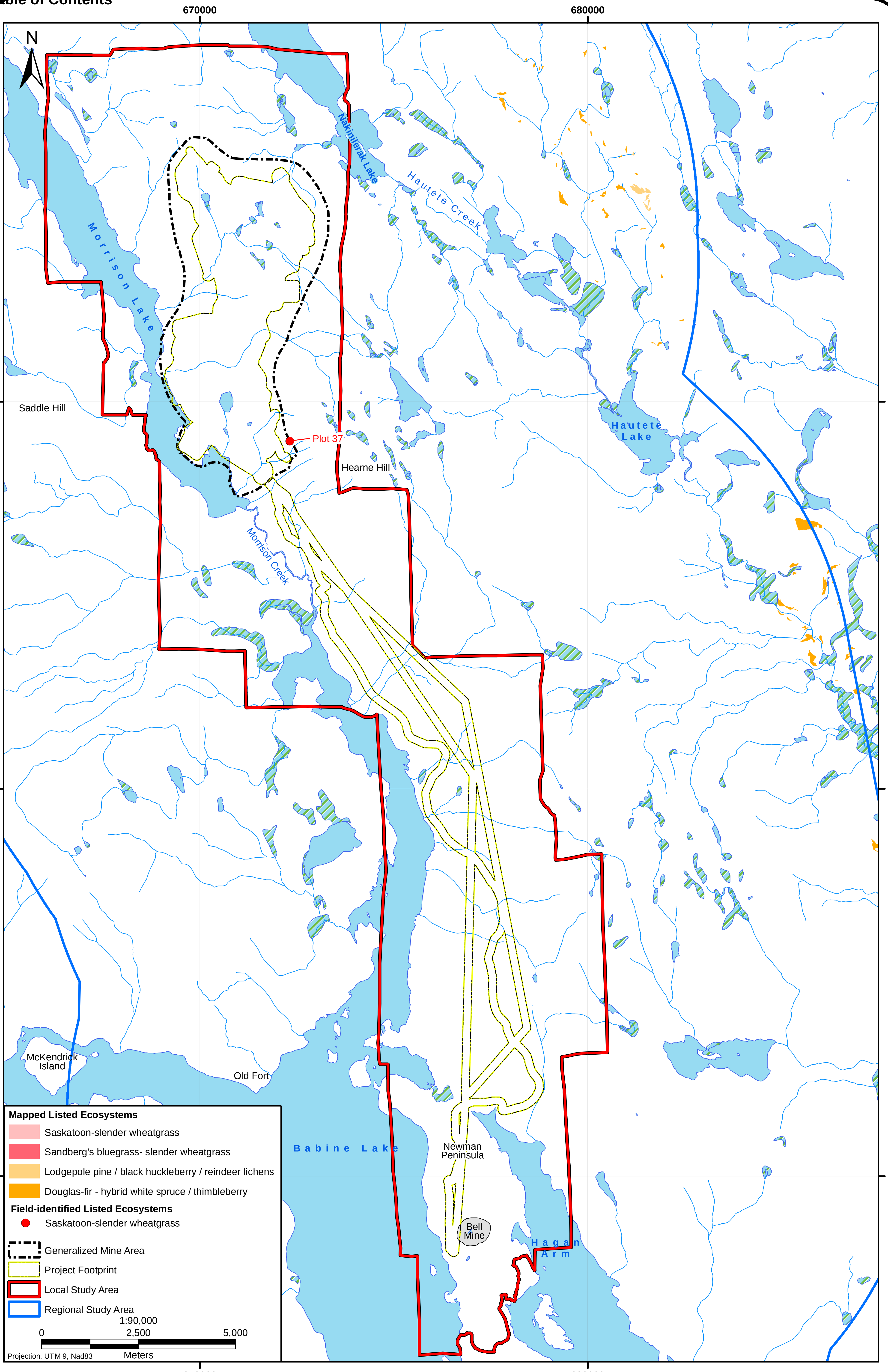

FIGURE 3.5-1

Morrison Copper/Gold Project Listed Ecosystem Locations

3.5.2 Riparian Ecosystems

There are 339 ha of riparian ecosystems within the footprint area, 2,248 ha within the LSA, and 12,833 ha within the RSA (Figure 3.5-2).

3.5.3 Wetland and Transitional Ecosystems

The extent of wetland and transitional ecosystems in the footprint, LSA, and RSA is shown in Table 3.5-1. Wetland and transitional ecosystems cover a total of 68 ha of the footprint area, 457 ha in the LSA, and 4,595 ha in the RSA. Forested swamps and non-treed bogs/marshes are the most common of these ecosystems. Other wetland and transitional ecosystems are relatively rare, the majority of which are only present within the RSA. More detailed information on wetlands in the Project area is provided in the *Morrison Wetland Baseline Studies Report* (Rescan 2009c).

Table 3.5-1
Extent of Wetland and Transitional Ecosystems within the Study Areas

Ecosystem	General Ecosystem Type	Footprint Area (ha)	LSA (ha)	RSA (ha)
Alpine wetland	Wetland Shrub/Herb			19
Cow-parsnip meadow	Wetter Shrub/Herb			22
Riparian shrub	Wetter Shrub/Herb			2
Non-treed bog/marsh	Wetland shrub/herb	26	259	1,277
Organic sedge fen	Wetland Shrub/Herb		6	13
Organic treed fen	Wetter Forest			121
Organic shrub fen	Wetland Shrub/Herb			14
Swamp forest	Wetter Forest	39	182	1,661
Shrub-carr	Wetter Shrub/Herb			159
Low bench floodplain	Wetter Shrub/Herb	3	3	17
Wet meadow	Wetter Shrub/Herb			1,252
Total		**68**	**457**	**4,595**

3.6 Metal Concentrations in Plant Tissue

Forty-nine plant tissue samples were collected from the footprint area in September, 2006, August, 2007, and July, 2008. The leaves of red osier dogwood (*Cornus stolonifera*), black twinberry (*Lonicera involucrata*), willow (*Salix* spp.), and highbush-cranberry (*Viburnum edule*) were collected in 2006. In 2007, the stems of wild rhubarb (*Heracleum lanatum*) and the berries of highbush-cranberry, huckleberry (*Vaccinium membranaceum*), and raspberry (*Rubus idaeus*) were also collected. Additional samples of the leaves of black twinberry and highbush-cranberry were collected in 2008.

There are no provincial or federal guidelines for metal limits in vegetation. Plant species have unique uptake characteristics, resulting in variable concentrations of metals between plant species. Certain tissues (e.g., stems and berries) within a plant may also have specific uptake or retention characteristics for metals, complicating comparisons of different types of tissues of the same species. Appendix 15 presents the analytical results for total metals in vegetation tissue collected from 2006 to 2008.

Table 3.6-1 presents the summary results for 2006 samples as wet and dry weights. Wet weight concentrations represent *in situ* conditions under which wildlife or humans consume these plants. Dry weight concentrations are independent of plant moisture content. In general, for both wet and dry weights, willow leaves had the highest average concentrations for more metals than did the leaves of other species. Highbush-cranberry had the highest average concentrations for several other metals. These results show the species-dependent differences in metal concentrations, and may reflect the heterogeneity of the environment (e.g., soil and water) from which plants uptake metals.

Wet weights for berry samples collected in 2007 are presented in Table 3.6-2. Berries have higher moisture content than leaves, making wet weight concentrations of metals lower. For most berries, 17 of the 28 metals were below detection limits. Raspberry concentrations were the highest for nine metals, while wild rhubarb was the highest in three metals. Highbush-cranberry and huckleberries had comparatively low average metal concentrations.

Dry weights for leaf samples collected in 2008 are presented in Table 3.6-3 for highbush-cranberry and one black twinberry sample. Dry leaf comparisons of highbush-cranberry from 2006 and 2008 show that the same metals were below detection limits in both years (antimony, arsenic, beryllium, bismuth, lithium, selenium, thallium, tin, uranium, and vanadium).

Plant tissue metal concentrations are presented by sampling location (the proposed MFA and the TLSC) in tables 3.6-4 to 3.6-6 for 2006 to 2008 samples, respectively. Total metal concentrations between the proposed MFA and TLSC were similar over all three sampling years. Average concentrations were similar for the two sampling areas. However, the maximum concentrations were variable because all species were grouped for comparison, and maximums may reflect differences in species-specific metal retention. The metals that were below detection limits were similar among samples collected within the same year along the proposed MFA and the TLSC.

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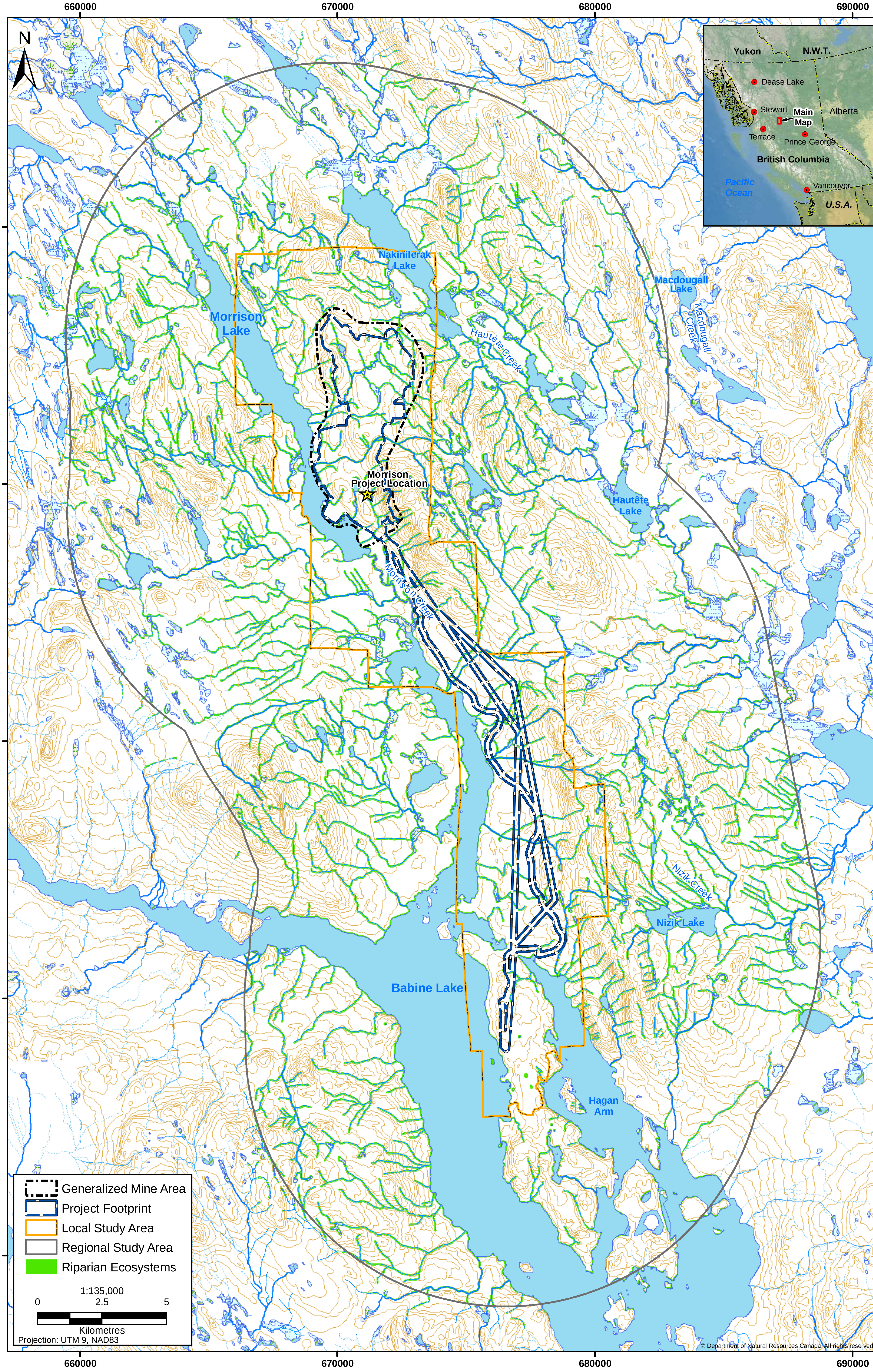

FIGURE 3.5-2

Morrison Copper/Gold Project Riparian Ecosystems in the Regional Study Area

pbm

Rescan

Table 3.6-1
Morrison Copper/Gold Project Metal Concentrations in Plant Tissue - 2006

Dry Weight											
Species		LONICERA INVOLUCRATA			SALIX			VIBURNUM EDULE			CORNUS STOLINIFERA
Number of Samples		2			2			4			1
Tissue Type		Leaf			Leaf			Leaf			Leaf
	Detection Limit	Mean	SE	Max	Mean	SE	Max	Mean	SE	Max	Value
Physical Tests											
Moisture (%)	0.1	74.2	1.3	75.4	70.8	3.05	73.8	74.4	2.2	78.9	78.9
Total Metals											
Aluminum	10	31.0	5	36.0	16.5	1.5	18.0	**140.0**	24.7	214.0	40.0
Antimony	0.050	0.025	0	0.025	0.025	0	0.025	0.025	0	0.025	0.025
Arsenic	0.050	0.025	0	0.025	0.025	0	0.025	0.025	0	0.025	0.025
Barium	0.050	122.0	20	142.0	20.0	9.55	29.5	156.2	31.8	245.0	**165.0**
Beryllium	0.30	0.150	0	0.150	0.150	0	0.150	0.150	0	0.150	0.150
Bismuth	0.30	0.150	0	0.150	0.150	0	0.150	0.150	0	0.150	0.150
Cadmium	0.030	0.336	0.093	0.429	**0.747**	0.643	1.390	0.048	0.003	0.056	0.015
Calcium	10	18,850	1,650	20,500	15,150	2,450	17,600	18,800	1,673	22,600	**31,200**
Chromium	0.50	0.25	0	0.25	0.25	0	0.25	**0.54**	0.11	0.80	0.25
Cobalt	0.10	0.05	0	0.05	**1.41**	0.71	2.12	0.05	0	0.05	0.05
Copper	0.050	5.22	0.26	5.48	**8.26**	2.745	11.00	3.63	0.31	4.48	3.46
Lead	0.10	0.05	0	0.05	0.05	0	0.05	0.20	0.15	0.63	0.05
Lithium	0.50	0.25	0	0.25	0.25	0	0.25	0.25	0	0.25	0.25
Magnesium	3.0	**3,680**	250	3,930	3,575	475	4,050	3,275	370	3,950	3,250
Manganese	0.050	69.30	6.60	75.90	243.95	167.05	411.00	46.18	5.76	61.90	42.30
Mercury	0.0050	**0.0254**	0.0019	0.0273	0.0232	0.0028	0.0260	0.0145	0.0013	0.0180	0.0178
Molybdenum	0.050	**1.57**	1.03	2.60	0.46	0.0105	0.47	0.26	0.18	0.78	0.13
Nickel	0.50	1.77	1.52	3.29	**6.53**	6.275	12.80	1.12	0.37	1.95	3.38
Selenium	1.0	0.50	0	0.50	0.50	0	0.50	0.50	0	0.50	0.50
Strontium	0.050	76.6	15.4	92.0	45.0	13.45	58.4	135.8	50.9	283.0	**144.0**
Thallium	0.030	0.015	0	0.015	0.015	0	0.015	0.015	0	0.015	0.015
Tin	0.20	0.10	0	0.10	0.10	0	0.10	0.10	0	0.10	0.10
Uranium	0.010	0.005	0	0.005	0.005	0	0.005	0.005	0	0.005	0.005
Vanadium	0.50	0.25	0	0.25	0.25	0	0.25	0.25	0	0.25	0.25
Zinc	0.50	57.65	10.15	67.80	**126.70**	62.3	189.00	21.65	3.15	29.90	13.30

(continued)

Table 3.6-1
Morrison Copper/Gold Project Metal Concentrations in Plant Tissue - 2006 (completed)

Wet Weight											
Species		**LONICERA INVOLUCRATA**			**SALIX**			**VIBURNUM EDULE**			**CORNUS STOLONIFERA**
Number of Samples		**2**			**2**			**4**			**1**
Tissue Type		**Leaf**			**Leaf**			**Leaf**			**Leaf**
	Detection Limit	**Mean**	**SE**	**Max**	**Mean**	**SE**	**Max**	**Mean**	**SE**	**Max**	**Value**
Total Metals											
Aluminum	4.0	7.9	1.0	8.9	4.8	0	4.8	**36.7**	8.7	61.6	8.4
Antimony	0.020	0.0075	0.003	0.0100	0.0100	0	0.0100	0.0075	0	0.0100	0.005
Arsenic	0.020	0.0075	0.003	0.0100	0.0100	0	0.0100	0.0088	0	0.0100	0.005
Barium	0.020	31.8	6.5	38.3	5.6	3.1	7.7	**40.3**	10.1	70.6	34.7
Beryllium	0.20	0.075	0.025	0.100	0.100	0	0.100	0.075	0	0.100	0.050
Bismuth	0.20	0.075	0.025	0.100	0.100	0	0.100	0.075	0	0.100	0.050
Cadmium	0.0100	0.088	0.028	0.116	**0.200**	0.234	0.365	0.012	0.001	0.014	0.003
Calcium	4.0	4,890	650	5,540	4,505	1,648	5,670	4,750	420	5,870	**6,570**
Chromium	0.20	0.075	0.025	0.100	0.100	0	0.100	0.125	0.017	0.170	0.05
Cobalt	0.040	0.015	0.005	0.020	**0.391**	0.233	0.555	0.015	0	0.020	0.01
Copper	0.020	1.350	0.130	1.480	**2.325**	0.771	2.870	0.931	0.125	1.290	0.73
Lead	0.040	0.015	0.005	0.020	0.020	0	0.020	0.048	0	0.142	0.01
Lithium	0.20	0.075	0.025	0.100	0.100	0	0.100	0.075	0	0.100	0.05
Magnesium	2.0	952.0	108.0	1,060.0	**1,030.0**	42.4	1,060.0	841.8	120.3	1,050.0	683
Manganese	0.020	17.95	2.55	20.50	**66.40**	58.83	108.00	12.11	2.35	17.80	8.90
Mercury	0.0010	0.0066	0.0008	0.0074	0.0067	0.0001	0.0068	0.0036	0.0002	0.0041	0.0037
Molybdenum	0.020	**0.39**	0.25	0.64	0.13	0.02	0.15	0.06	0.04	0.18	0.03
Nickel	0.20	0.46	0.36	0.81	**1.72**	2.29	3.34	0.29	0.10	0.56	0.71
Selenium	0.40	0.15	0.1	0.20	0.20	0	0.20	0.15	0	0.20	0.10
Strontium	0.020	20.0	4.9	24.9	12.8	3.6	15.3	**32.6**	10.0	59.6	30.2
Thallium	0.020	0.008	0.003	0.010	0.010	0	0.010	0.008	0	0.010	0.01
Tin	0.100	0.038	0.013	0.050	0.050	0	0.050	0.038	0	0.050	0.03
Uranium	0.0040	0.0015	0.001	0.0020	0.0020	0	0.0020	0.0015	0	0.0020	0.0010
Vanadium	0.20	0.075	0.025	0.100	0.100	0	0.100	0.075	0	0.100	0.05
Zinc	0.20	15.00	3.3	18.30	**35.10**	20.22	49.40	5.66	1.14	8.59	2.80

Notes:
Units are expressed as mg/kg dry weight and mg/kg wet weight
Shaded values indicate 50% or more of samples are below detection limits
Bold values indicate the highest average concentration among all plants

Table 3.6-2
Morrison Copper/Gold Project Metal Concentrations in Plant Berries and Stems – 2007

Species		**VIBURNUM EDULE**			**VACCINIUM MEMBRANACEUM**			**RUBUS**			**RHUBARB**		
Number of Samples		**10**			**6**			**9**			**6**		
Tissue Type		**Berry**			**Berry**			**Berry**			**Stem**		
	Detection Limit	**Mean**	**SE**	**Max**	**Mean**	**SE**	**Max**	**Mean**	**SE**	**Max**	**Mean**	**SE**	**Max**
Total Metals													
Aluminum	2	2.67	0.59	6.60	3.62	0.42	5.10	**4.02**	1.42	15.10	1.85	0.42	3.50
Antimony	0.01	0.005	0	0.005	0.005	0	0.005	0.005	0	0.005	0.005	0	0.005
Arsenic	0.01	0.005	0	0.005	0.006	0.001	0.011	0.010	0.004	0.036	0.005	0	0.005
Barium	0.01	2.427	0.154	3.020	1.730	0.236	2.650	3.748	1.518	15.800	**4.280**	0.687	7.190
Beryllium	0.1	0.050	0	0.050	0.050	0	0.050	0.050	0	0.050	0.050	0	0.050
Bismuth	0.03	0.015	0	0.015	0.015	0	0.015	0.015	0	0.015	0.015	0	0.015
Cadmium	0.005	0.0057	0.0017	0.0196	0.0099	0.0029	0.0187	**0.0306**	0.0063	0.0506	0.0039	0.0009	0.0073
Calcium	2	295.2	16.8	387.0	158.6	33.2	320.0	430.7	31.9	598.0	**781.5**	112.4	1,210.0
Chromium	0.1	0.050	0	0.050	0.050	0	0.050	0.050	0	0.050	0.050	0	0.050
Cobalt	0.02	0.010	0	0.010	0.010	0	0.010	0.015	0.004	0.044	0.010	0	0.010
Copper	0.01	0.504	0.031	0.730	0.513	0.049	0.713	**0.802**	0.112	1.640	0.376	0.060	0.560
Iron	0.2	1.710	0.301	4.350	1.587	0.160	2.090	**7.271**	1.877	21.700	1.948	0.373	3.550
Lead	0.02	0.010	0	0.010	0.010	0	0.010	0.010	0	0.010	0.010	0	0.010
Lithium	0.1	0.050	0	0.050	0.050	0	0.050	0.050	0	0.050	0.050	0	0.050
Magnesium	1	146	7	173	85	13	148	**267**	11	316	148	12	189
Manganese	0.01	2.99	2.39	24.50	15.00	3.67	27.40	**22.32**	5.48	58.60	1.42	0.14	1.97
Mercury	0.001	0.0006	0.0001	0.0012	0.0011	0.0006	0.0043	0.0006	0.0001	0.0015	0.0009	0.0003	0.0021
Molybdenum	0.01	0.018	0.004	0.038	0.050	0.015	0.103	**0.085**	0.014	0.149	0.031	0.008	0.057
Nickel	0.1	0.07	0.01	0.14	0.05	0	0.05	**0.35**	0.09	1.04	0.05	0	0.05
Potassium	20	1,489	75	1,770	823	137	1,500	1,496	53	1,750	**4,670**	564	6,250
Selenium	0.2	0.10	0	0.10	0.10	0	0.10	0.10	0	0.10	0.10	0	0.10
Sodium	20	10	0	10	10	0	10	10	0	10	12	2	21
Strontium	0.01	1.11	0.13	1.93	0.29	0.06	0.57	2.02	0.54	6.27	**4.99**	1.74	13.40
Thallium	0.01	0.005	0	0.005	0.005	0	0.005	0.005	0	0.005	0.005	0	0.005
Tin	0.05	0.032	0.01	0.069	0.025	0	0.025	0.046	0.021	0.216	0.025	0	0.025
Titanium	0.1	0.050	0	0.050	0.050	0	0.050	0.483	0.315	2.940	0.058	0.008	0.100
Uranium	0.002	0.001	0	0.001	0.001	0	0.001	0.001	0	0.001	0.001	0	0.001
Vanadium	0.1	0.050	0	0.050	0.050	0	0.050	0.050	0	0.050	0.050	0	0.050
Zinc	0.1	1.577	0.072	1.850	1.047	0.131	1.480	**4.183**	0.206	5.200	3.557	0.396	5.280

Notes:
Units are expressed as mg/kg wet weight
Shaded values indicate 50% or more of samples are below detection limits
Bold values indicate the highest average concentration among all plants

Table 3.6-3
Morrison Copper/Gold Project Metal Concentrations in Plant Leaves – 2008

Species		VIBURNUM EDULE			LONICERA INVOLUCRATA
Number of Samples			8		1
Tissue Type			Leaf		Leaf
	Detection Limit	Mean	SE	Max	Value
% Moisture		71.6	1.3	76.6	66.5
Total Metals					
Aluminum	2	**17.9**	4.1	36.6	8.6
Antimony	0.01	0.005	0	0.005	0.005
Arsenic	0.01	0.007	0.001	0.013	**0.011**
Barium	0.01	**41.0**	7.4	68.8	13.3
Beryllium	0.1	0.05	0	0.05	0.05
Bismuth	0.03	0.015	0	0.015	0.015
Cadmium	0.005	0.032	0.006	0.049	**0.061**
Calcium	2	**3,770**	251	4,620	2,510
Chromium	0.1	0.090	0.018	0.190	**0.120**
Cobalt	0.02	**0.012**	0.002	0.023	0.010
Copper	0.01	1.48	0.08	1.86	**2.33**
Iron	0.2	15.1	1.5	21.3	**23.6**
Lead	0.02	0.02	0.003	0.03	0.02
Lithium	0.1	0.05	0	0.05	0.05
Magnesium	1	716	64	1,070	**720**
Manganese	0.01	**9.70**	1.17	15.40	8.64
Mercury	0.001	0.002	0.0001	0.003	**0.004**
Molybdenum	0.01	0.035	0.007	0.071	**0.126**
Nickel	0.1	0.27	0.10	0.90	**0.35**
Potassium	20	4,921	409	6,510	**6,990**
Selenium	0.2	0.1	0	0.1	0.1
Sodium	20	10	0	10	10
Strontium	0.01	**19.63**	2.62	29.80	8.63
Thallium	0.01	**0.006**	0.001	0.012	0.005
Tin	0.05	0.025	0	0.025	0.025
Titanium	0.1	0.22	0.03	0.34	**0.37**
Uranium	0.002	0.001	0	0.001	0.001
Vanadium	0.1	0.05	0	0.05	0.05
Zinc	0.1	9.5	1.3	17.7	**12.6**

Notes:
Units are expressed as mg/kg dry weight
Shaded values indicate 50% or more of samples are below detection limits
Bold values indicate the highest average concentration among all plants

Table 3.6-4
Morrison Copper/Gold Project Vegetation Metal Concentrations in the Mine Facilities Area and Transmission Line Study Corridor – 2006

Sampling Area		Mine Facilities Area			Transmission Line Study Corridor		
Number of Samples		6			3		
	Detection Limit	Mean	SE	Max	Mean	SE	Max
Total Metals							
Aluminum	4	21.0	9.4	61.6	18.1	6.7	26.3
Antimony	0.02	0.01	0	0.01	0.01	0	0.01
Arsenic	0.02	0.01	0	0.01	0.01	0	0.01
Barium	0.02	33.4	9.0	70.6	23.3	7.8	31.5
Beryllium	0.2	0.08	0.01	0.10	0.07	0.02	0.10
Bismuth	0.2	0.08	0.01	0.10	0.07	0.02	0.10
Cadmium	0.01	0.04	0.02	0.12	0.13	0.12	0.37
Calcium	4	5,401.7	356.0	6,570.0	3,983.3	415.3	4,760.0
Chromium	0.2	0.11	0.02	0.20	0.13	0.02	0.17
Cobalt	0.04	0.05	0.04	0.23	0.19	0.18	0.56
Copper	0.02	1.23	0.16	1.78	1.47	0.70	2.87
Lead	0.04	0.02	0	0.02	0.06	0.04	0.14
Lithium	0.2	0.08	0.01	0.10	0.07	0.02	0.10
Magnesium	2	935.7	59.6	1,060.0	800.0	160.5	1,060.0
Manganese	0.02	16.9	2.2	24.8	41.6	33.2	108.0
Mercury	0.001	0.005	0.001	0.007	0.005	0.001	0.007
Molybdenum	0.02	0.17	0.10	0.64	0.10	0.05	0.18
Nickel	0.2	0.4	0.1	0.8	1.2	1.1	3.3
Selenium	0.4	0.2	0	0.2	0.1	0.03	0.2
Strontium	0.02	22.4	3.9	35.7	30.6	14.5	59.6
Thallium	0.02	0.01	0	0.01	0.01	0	0.01
Tin	0.1	0.04	0.01	0.05	0.03	0.01	0.05
Uranium	0.004	0.002	0	0.002	0.001	0.0003	0.002
Vanadium	0.2	0.1	0	0.1	0.1	0	0.1
Zinc	0.2	11.4	2.9	20.8	19.2	15.1	49.4

Notes:
Units are expressed as mg/kg wet weight
Shaded values indicate 50% or more of samples are below detection limits

Table 3.6-5
Morrison Copper/Gold Project Vegetation Metal Concentrations in the Mine Facilities Area and Transmission Line Study Corridor - 2007

Species		Proposed Mine Facilities Area			Transmission Line Study Corridor		
Number of Samples		20			11		
	Detection Limit	Mean	SE	Max	Mean	SE	Max
Total Metals							
Aluminum	2	3.72	0.68	15.10	1.95	0.31	3.60
Antimony	0.01	0.005	0.0	0.005	0.005	0.0	0.005
Arsenic	0.01	0.008	0.002	0.036	0.005	0.0	0.005
Barium	0.01	2.85	0.69	15.80	3.37	0.49	7.19
Beryllium	0.1	0.05	0	0.05	0.05	0	0.05
Bismuth	0.03	0.015	0	0.015	0.015	0	0.015
Cadmium	0.005	0.0185	0.004	0.0506	0.0041	0.001	0.0073
Calcium	2	304.12	31.87	598.00	580.55	91.65	1,210.00
Chromium	0.1	0.05	0	0.05	0.05	0	0.05
Cobalt	0.02	0.01	0.002	0.04	0.01	0	0.01
Copper	0.01	0.629	0.061	1.640	0.457	0.052	0.819
Iron	0.2	3.93	1.06	21.70	2.28	0.39	4.86
Lead	0.02	0.01	0	0.01	0.01	0	0.01
Lithium	0.1	0.05	0	0.05	0.05	0	0.05
Magnesium	1	170.67	18.70	316.00	168.00	15.05	277.00
Manganese	0.01	15.33	3.33	58.60	2.06	0.65	6.45
Mercury	0.001	0.0008	0.0002	0.0043	0.0007	0.0002	0.0021
Molybdenum	0.01	0.047	0.010	0.149	0.043	0.010	0.125
Nickel	0.1	0.18	0.05	1.04	0.08	0.02	0.29
Potassium	20	1,259	85	1,750	3,285	563	6,250
Selenium	0.2	0.1	0	0.1	0.1	0	0.1
Sodium	20	10	0	10	11	1	21
Strontium	0.01	1.20	0.29	6.27	3.37	1.07	13.40
Thallium	0.01	0.005	0	0.005	0.005	0	0.005
Tin	0.05	0.037	0.010	0.216	0.028	0.003	0.055
Titanium	0.1	0.25	0.15	2.94	0.05	0.005	0.10
Uranium	0.002	0.001	0	0.001	0.001	0	0.001
Vanadium	0.1	0.05	0	0.05	0.05	0	0.05
Zinc	0.1	2.36	0.34	5.20	3.07	0.36	5.28

Notes:
Units are expressed as mg/kg wet weight
Shaded values indicate 50% or more of samples are below detection limits

Table 3.6-6
Morrison Copper/Gold Project Vegetation Metal Concentrations in the Mine Facilities Area and Transmission Line Study Corridor – 2008

Species		Proposed Mine Facilities Area			Transmission Line Study Corridor		
Number of Samples			4			4	
	Detection Limit	Mean	SE	Max	Mean	SE	Max
% Moisture		72.8	2.8	76.6	70.9	1.6	73.2
Total Metals							
Aluminum	2	14.4	7.5	36.6	18.8	5.0	28.1
Antimony	0.01	0.01	0	0.01	0.01	0	0.005
Arsenic	0.01	0.010	0	0.013	0.006	0	0.010
Barium	0.01	28.50	11.49	62.10	46.40	11.29	68.80
Beryllium	0.1	0.05	0	0.05	0.05	0	0.05
Bismuth	0.03	0.02	0	0.02	0.02	0	0.015
Cadmium	0.005	0.0322	0.0134	0.0606	0.0364	0.0048	0.0423
Calcium	2	3,185	469	4380	3,980	271	4,620
Chromium	0.1	0.10	0.034	0.19	0.10	0.015	0.11
Cobalt	0.02	0.01	0.003	0.02	0.01	0	0.01
Copper	0.01	1.59	0.27	2.33	1.48	0.05	1.57
Iron	0.2	16.60	3.15	23.60	14.98	2.20	21.30
Lead	0.02	0.02	0	0.03	0.03	0.002	0.03
Lithium	0.1	0.05	0	0.05	0.05	0	0.05
Magnesium	1	641	49	720	753	110	1,070
Manganese	0.01	8.25	1.18	11.30	10.90	1.98	15.40
Mercury	0.001	0.002	0.0004	0.004	0.002	0.00021	0.0027
Molybdenum	0.01	0.07	0.02	0.13	0.03	0.00649	0.041
Nickel	0.1	0.35	0.19	0.90	0.21	0.06	0.38
Potassium	20	5,375	934	6,990	5,035	433	5,820
Selenium	0.2	0.10	0	0.10	0.10	0	0.10
Sodium	20	10	0	10	10	0	10
Strontium	0.01	13.91	3.98	24.40	21.05	3.41	29.80
Thallium	0.01	0.005	0.0	0.005	0.007	0.002	0.012
Tin	0.05	0.025	0	0.025	0.025	0	0.025
Titanium	0.1	0.25	0.06	0.37	0.22	0.04664	0.34
Uranium	0.002	0.001	0.0	0.001	0.001	0	0.001
Vanadium	0.1	0.05	0	0.05	0.05	0	0.05
Zinc	0.1	8.23	1.53	12.60	11.36	2.25	17.7

Notes:
Units are expressed as mg/kg wet weight
Shaded values indicate 50% or more of samples are below detection limits

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