## TABLE OF CONTENTS

5.1.3 Terrestrial Environment ........ 5.1.3-1
5.1.3.1 Geology and Geochemistry ........ 5.1.3-1
5.1.3.1.1 History ........ 5.1.3-1
5.1.3.1.2 Regional Geology ........ 5.1.3-1
5.1.3.1.3 Local and Project Geology ........ 5.1.3-2
5.1.3.1.4 Project Mineralization ........ 5.1.3-5
5.1.3.1.5 Richfield and New Gold Drilling Programs ........ 5.1.3-5
5.1.3.1.6 Drill Core Sample Analysis ........ 5.1.3-5
5.1.3.1.7 Mineral Resource Estimates ........ 5.1.3-6
5.1.3.1.8 Geochemistry ........ 5.1.3-8
5.1.3.2 Soils and Terrain ........ 5.1.3-14
5.1.3.2.1 Introduction ........ 5.1.3-14
5.1.3.2.2 Methods ........ 5.1.3-14
5.1.3.2.3 Baseline Terrain and Soil Conditions ........ 5.1.3-18
5.1.3.3 Vegetation ........ 5.1.3-26
5.1.3.3.1 Introduction ........ 5.1.3-26
5.1.3.3.2 Scope of Work ........ 5.1.3-28
5.1.3.3.3 Methods ........ 5.1.3-30
5.1.3.3.4 Results ........ 5.1.3-36
5.1.3.4 Wildlife and Wildlife Habitat ........ 5.1.3-50
5.1.3.4.1 Introduction ........ 5.1.3-54
5.1.3.4.2 Habitat ........ 5.1.3-60
5.1.3.4.3 Amphibians and Reptiles ........ 5.1.3-61
5.1.3.4.4 Forest and Grassland Birds ........ 5.1.3-61
5.1.3.4.5 Water Birds ........ 5.1.3-62
5.1.3.4.6 Mammals ........ 5.1.3-63
5.1.3.4.7 Invertebrates ........ 5.1.3-65
5.1.3.4.8 Rare and Listed Species ........ 5.1.3-65
5.1.3.4.9 Species of Importance to Humans ........ 5.1.3-65

## TABLE OF CONTENTS (cont.)

### List of Tables

Table 5.1.3.1-1: Drill Database Lithological Codes ..... 5.1.3-4
Table 5.1.3.1-2: Measured, Indicated, and Inferred Resources ..... 5.1.3-8
Table 5.1.3.1-3: Geochemistry Testwork Summary ..... 5.1.3-10
Table 5.1.3.1-4: Acid Rock Drainage Classification of Project Samples ..... 5.1.3-11
Table 5.1.3.1-5: Waste Rock and Overburden Tonnages ..... 5.1.3-12
Table 5.1.3.2-1: Soil Depth and Soil Horizons ..... 5.1.3-19
Table 5.1.3.2-2: Summary of Soil Associations in the Project Study Area ..... 5.1.3-21
Table 5.1.3.3-1: Relationship between BGC Unit and Old Growth Forest ..... 5.1.3-34
Table 5.1.3.3-2: Number of Plots and Percent Polygons Inspected by Project Component within the LSA ..... 5.1.3-37
Table 5.1.3.3-3: Ecosystems at Risk Potentially Occurring Within the Project Area ..... 5.1.3-42
Table 5.1.3.3-4: Berry-producing Plants that Occur in the Project Area. ..... 5.1.3-43
Table 5.1.3.3-5: Ecosystems with Berry-Producing Potential ..... 5.1.3-44
Table 5.1.3.3-6: Potential Berry-producing Ecosystems in the Project area LSA. ..... 5.1.3-45
Table 5.1.3.4-1: Wildlife RISC Survey Methodology. ..... 5.1.3-55
Table 5.1.3.4-2: Summary of Survey Effort Completed for Each of the LSAs / RSAs in 2011 and 2012 for the Proposed Project ..... 5.1.3-57

### List of Figures

Figure 5.1.3.1-1: Blackwater Project Location and Tectono-stratigraphic Setting ..... 5.1.3-2
Figure 5.1.3.1-2: Rate of Lithospheric Uplift ..... 5.1.3-3
Figure 5.1.3.1-3: Top of Bedrock Geology in Vicinity of Blackwater Deposit ..... 5.1.3-4
Figure 5.1.3.2-1: Soils Local and Regional Study Areas Blackwater Gold Project ..... 5.1.3-16
Figure 5.1.3.3-1: Vegetation Local and Regional Study Areas Blackwater Gold Project ..... 5.1.3-29
Figure 5.1.3.3-2: Terrestrial Ecosystem Mapping and Plant Species at Risk Survey Locations ..... 5.1.3-32
Figure 5.1.3.3-3: Distribution of Ecoregions and Ecosections in the LSA ..... 5.1.3-38
Figure 5.1.3.3-4: Distribution of Biogeoclimatic Subzones and Variants ..... 5.1.3-39
Figure 5.1.3.3-5: Distribution of Whitebark Pine (Pinus albicaulis) ..... 5.1.3-48
Figure 5.1.3.3-6: Invasive Plants Documented by IAPP ..... 5.1.3-49
Figure 5.1.3.4-1: Wildlife and Wildlife Habitat Study Areas ..... 5.1.3-51
Figure 5.1.3.4-2: Caribou Study Areas ..... 5.1.3-52
Figure 5.1.3.4-3: Grizzly Bear Study Areas ..... 5.1.3-53

### List of Appendices

Appendix 5.1.3.1A: 2013 Geochemical Characterization Report (AMEC E&I)
Appendix 5.1.3.2A: Soils, Terrain, and Surficial Geology 2013 Baseline Report (AMEC E&I)
Appendix 5.1.3.2B: AMEC Laboratory Quality Assurance/Control Program (AMEC E&I)
Appendix 5.1.3.3A: Vegetation 2011-2013 Baseline Report (AMEC E&I)
Appendix 5.1.3.4A: Wildlife and Wildlife Habitat 2011-2013 Baseline Report (AMEC E&I)

### 5.1.3 Terrestrial Environment

This section provides a description of the baseline condition of the proposed Blackwater Gold Project (the Project) for the Terrestrial Environment, which includes:

- Geology and Geochemistry (**Section 5.1.3.1**);
- Soils and Terrain (**Section 5.1.3.2**);
- Vegetation (**Section 5.1.3.3**); and
- Wildlife and Wildlife Habitat (**Section 5.1.3.4**).

#### 5.1.3.1 Geology and Geochemistry

##### 5.1.3.1.1 History

The Blackwater deposit at the Project is an example of an epithermal-style deposit. The geological setting, style of gold-silver mineralization, and associated alteration assemblage for the Blackwater deposit share the characteristics of both low and intermediate sulphidation epithermal deposit types, according to the classification system of Sillitoe and Hedenquist (2003).

Granges discovered mineralization on the Project property in 1973 during a regional silt geochemical survey. The survey located anomalous zinc and other metals in stream sediments east and north of the Project area. Between 1973 and 1985, numerous ground and airborne geophysical and geochemical surveys were conducted to locate and delimit mineralization.

Drilling began in 1985 and continued to 1994 for a total of 6,300 m in 75 holes. Silver Quest completed a further 1,333 m of drilling in seven holes in winter 2005-2006. Richfield began work on the Project in 2009 when the company recognized the bulk gold potential of the Project property. In 2009, Richfield optioned the Davidson claims from Silver Quest and the Dave claim and Jarrit claim from the Rozek family. In June 2011, New Gold Inc. (Proponent) acquired all of the issued and outstanding common shares of Richfield pursuant to a court-approved plan of arrangement. In December 2011, the Proponent acquired all of the issued and outstanding common shares of Silver Quest and a third company, Geo Minerals Limited. The Proponent subsequently amalgamated with Richfield, Silver Quest, and Geo, effective 1 January 2012, and became the direct operator of the Project.

No mineral production has taken place in the Project area.

##### 5.1.3.1.2 Regional Geology

The Project is located on the Nechako Plateau that is part of the Intermontane Belt superterrane situated between the Coast Belt to the west and the Omineca Belt to the east (**Figure 5.1.3.1-1**).

The Project area is underlain by rocks of the accreted Stikine terrane, comprising an assemblage of magmatic arc and related sedimentary rocks that span Jurassic to early Tertiary periods. These rocks have been exposed within an easterly trending structural high termed the Nechako uplift.

The Nechako uplift is bounded to the north and south by the northeast-striking Natalkuz and Blackwater faults, respectively (Diakow and Levson, 1997; Diakow et al., 1997). The latest extensional displacement along these faults juxtaposes older Mesozoic and Tertiary rocks in the central part of the uplift against younger Cretaceous and Tertiary volcanic rocks to the north and south (Diakow and Webster, Diakow and Levson, 1997, 1994; Friedman et al., 2001). The northwesterly trending Chedakuz fault and adjacent Nechako range transect the uplift and mark the eastern limit of the Project area. To the west, the Nechako uplift extends into a provincial park well beyond the area currently being explored by the Proponent.

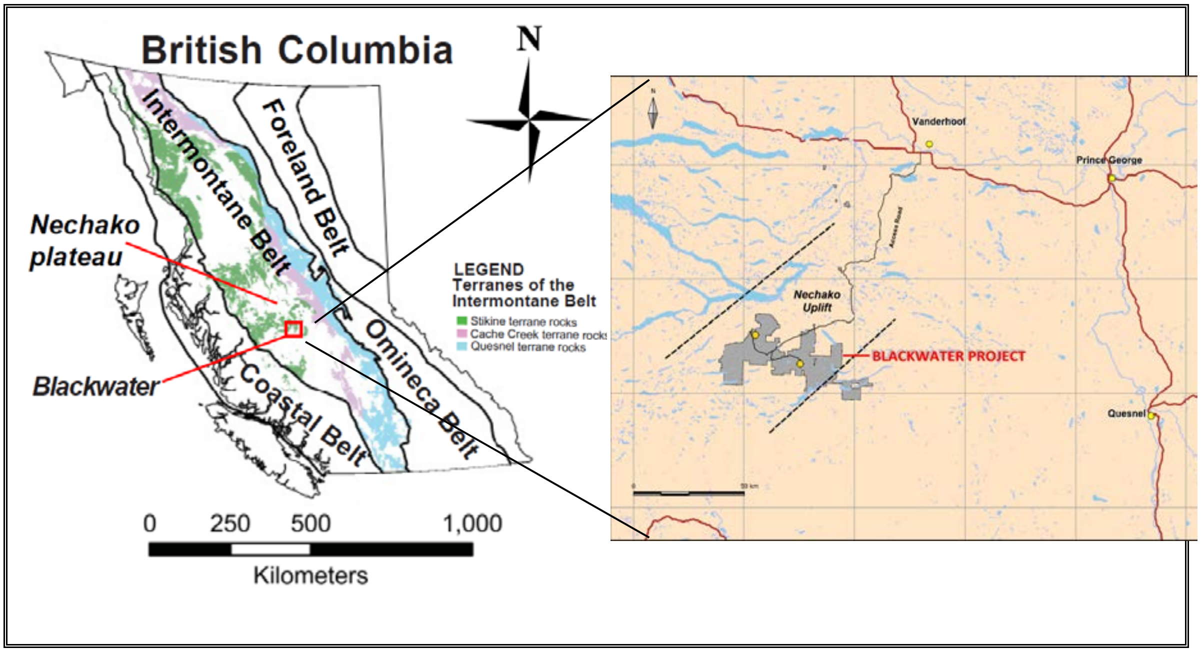
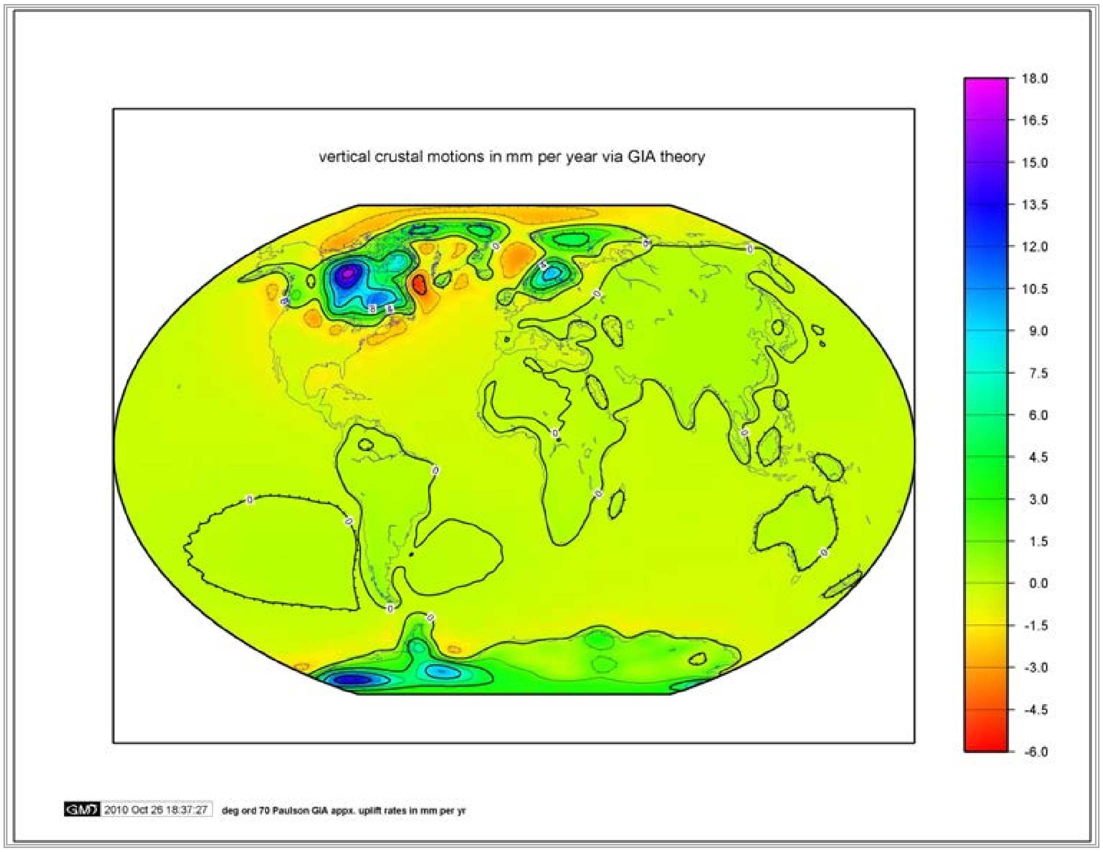



***Figure 5.1.3.1-1: Blackwater Project Location and Tectono-stratigraphic Setting***

### 5.1.3.1.3 Local and Project Geology

Quaternary glacial overburden, colluvial, and fluvial deposits mask the majority of bedrock within the Project area. Outcrop is sparse and limited to peak and ridges and streams draining the flanks of Mt. Davidson.

Isostatic rebound is not a concern in the Project area. Isostatic rebound is the rise of land masses that were depressed by the huge weight of ice sheets during the last glacial period. Isostatic rebound is significant in areas of Canada where the ice sheet was thickest during the last ice age, for example Baffin Island, Nunavut, the Great Lakes, and Hudson Bay area. In the Project area, the terrain is considered stable with very minimal rebound on the order of less than 1 mm per year (**Figure 5.1.3.1-2**).




**Source**: Paulson et al., 2007

***Figure 5.1.3.1-2: Rate of Lithospheric Uplift***

The Project site is underlain by a sequence of volcanic units: a late Cretaceous age lower sequence of andesite, felsic volcaniclastic rock, heterolithic breccias and tuff, which host the Blackwater deposit; and an upper sequence of post-mineral Eocene age felsic volcanic and fragmental rocks and mafic to intermediate flows belonging to the Ootsa Lake Group.

**Figure 5.1.3.1-3** is a sketch map of the top-of-bedrock geology for the Project development area.

Host rocks of the Blackwater deposit are pervasively hydrofractured, pyritized, and altered to a mixture of silica and sericite. Locally, the amount of silica introduced through hydrofracturing and silicification may amount to 25% or more of the total volume of altered host rocks. At the deposit scale, interpretation and correlation of clearly recognizable faults is made difficult by the intense hydrofracturing and multiple fault sets. Instead, extensive zones of broken rocks are seen in the mineralized zone that grade laterally into unbroken rock.

The lithological codes used in the Blackwater drill-hole database have been defined according to observed descriptive criteria only. The codes do not include assignment of individual rock units to interpreted regional stratigraphy. The lithological codes are summarized in **Table 5.1.3.1-1**.

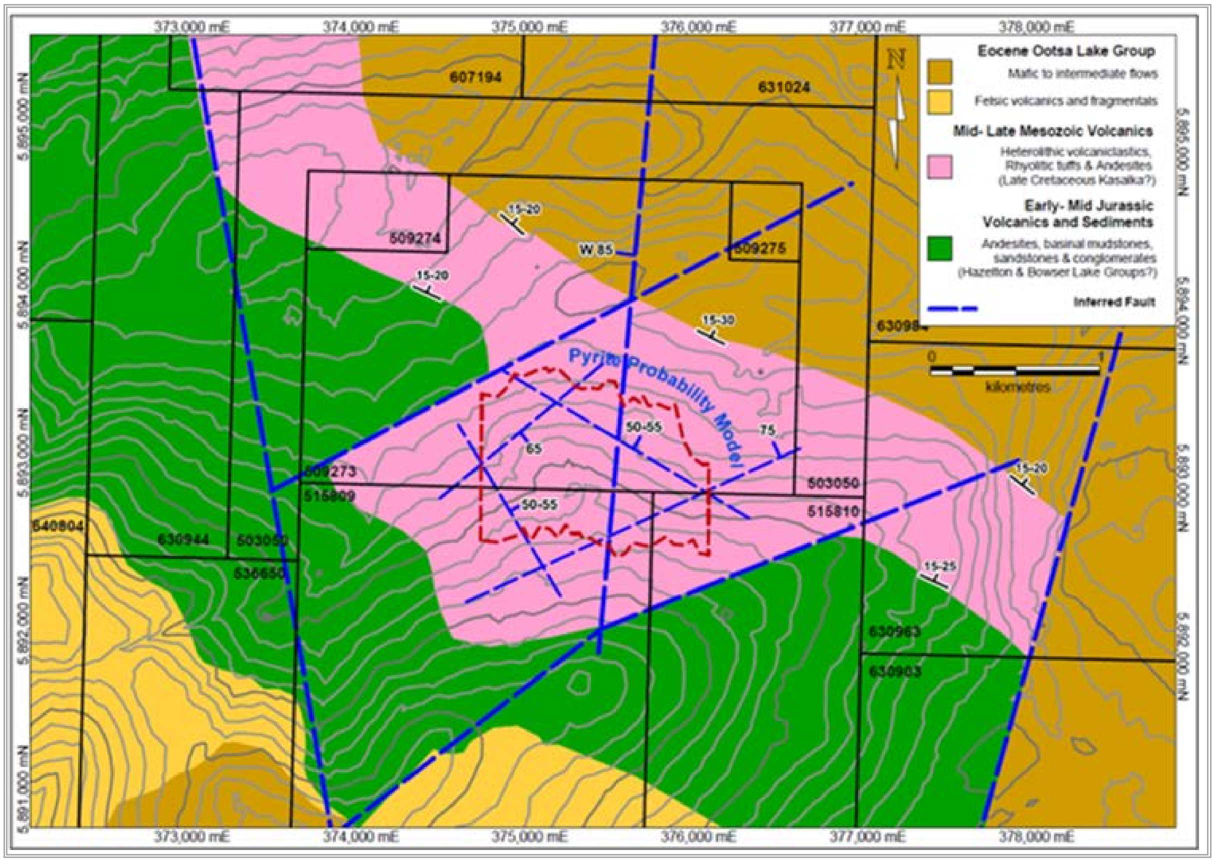



***Figure 5.1.3.1-3: Top of Bedrock Geology in Vicinity of Blackwater Deposit***

***Table 5.1.3.1-1: Drill Database Lithological Codes***

| Code | Description |
|---|---|
| OB | Overburden |
| AND | Andesite |
| FT | Felsic tuff |
| FLPT | Fesic lapilli tuff |
| VC | Volcaniclastic |
| EC | Epiclastic |
| SED | Argillite/Sandstone/Conglomerate |

#### 5.1.3.1.4 Project Mineralization

In general, all rocks of the Blackwater deposit are mineralized, with trace pyrite-pyrrhotite-sphalerite in outboard andesite flows and volcaniclastics, or as gold-bearing polymetallic sulphide mineralization within the fragmental unit of the deposit.

Pervasive stockwork-veined and -disseminated sulphide mineralization is hosted within felsic to intermediate composition volcanic rocks that have undergone extensive silicification and hydrofracturing. Drilling has defined a continuous zone of gold mineralization that extends at least 1,300 m along its longest dimension east-west and at least 950 m north-south. The thickness of the zone ranges up to 600 m.

Gold-silver mineralization is associated with a variable assemblage of pyrite-sphalerite-marcasite-pyrrhotite ± chalcopyrite ± galena ± arsenopyrite (± stibnite ± tetrahedrite ± bismuthite).

Sulphide mineralization can occur as disseminations, porosity infill, veins and veinlets, hydrothermal brecciation and related silcification, and structure related.

#### 5.1.3.1.5 Richfield and New Gold Drilling Programs

A total of 1,149 core drill holes (357,507 m) have been drilled at the Project area between 2009 and January 2013 by Richfield and the Proponent. The exploration drilling carried out since 2009 has been predominantly HQ diameter (63.5 mm) diamond drill core except where a reduction to NQ diameter (47.6 mm) was required to attain target depths. Twenty-three metallurgical holes (BWMET05 to BWMET27) and one deep hole (BW0364) were PQ diameter (85 mm) core. Ninety-one reverse circulation holes were drilled as part of a condemnation program.

Drilling programs were undertaken specifically for geotechnical, hydrological, metallurgical, and acid rock drainage (ARD) characterization programs.

Drill core is logged at the Project site and includes geotechnical, magnetic susceptibility, and specific gravity measurements taken at regular intervals. Lithology is logged and the core prepared for systematic sampling at regular 1 m intervals. Recovery and rock quality designation (RQD) data were measured and recorded. Core recovery for the drilling programs completed from 2009 to 2012 averaged 92% and had a median core recovery of 96%. Poor core recovery often occurs in zones of faulting and fracturing.

#### 5.1.3.1.6 Drill Core Sample Analysis

The sample preparation, security, and analytical procedures used by the Proponent for the Project have ensured the validity and integrity of all samples taken. Data from holes drilled between 1981 and 1994 have no documented Quality Assurance/Quality Control (QA/QC) information, and they have not been used in resource estimation.

Eco Tech Laboratory Stewart Group (Eco Tech) in Kamloops and ALS Mineral (ALS) laboratories in Vancouver, Vanderhoof, Terrace, Reno, and Elko were used for sample preparation. Eco Tech in Kamloops and ALS in North Vancouver were used as the primary assay laboratories. Both laboratories are accredited.

Drill core samples were prepared using standard crush, split, and pulverise sample preparation procedures. Fire Assay Atomic Absorption Spectrometry (FA ASS) was used to analyze gold pulverized samples. Eco Tech samples were initially assayed for silver by aqua-regia digestion (AR) and AAS finish, and later by AR and induction-coupled plasma spectrometry atomic emission spectrometry (ICP AES) finish. ALS samples were analyzed for silver by four-acid digestion ICP AES finish until July 2012, after which time silver was analyzed by a four-acid digestion AAS. Assay procedures also include a multi-element package by AR and ICP AES finish.

QA/QC protocols included "blind" insertion of certified reference material (CRM) standards, blanks, quarter-hole (field duplicate), coarse reject, and pulp duplicates. The drill hole database was supported by some 80,000 QA/QC check assays. All standards, duplicates, and blanks met acceptable QA/QC limits.

Ronald G. Simpson, an independent Qualified Person engaged by the Proponent, conducted site visits from 2010 to 2013 and reviewed the sampling and QA/QC procedures. The drill hole database was audited and verified by GeoSim and AMEC.

#### 5.1.3.1.7 Mineral Resource Estimates

The mineral resource presented here was taken from the Feasibility Study (FS) (AMEC, 2013). Additional information on the development of the resource estimate is presented in **Section 2.2** of the Project Overview. The FS resource estimate includes data for all drilling completed by Richfield and the Proponent between 1 August 2009 and 16 January 2013. The total sample database for the Project contains results from 1,046 core holes totalling 315,319 m drilled between January 1987 and 15 January 2013. Due to lack of QA/QC and accurate survey information, holes drilled prior to 2009 were not used for geologic modelling, statistical analysis, or grade estimation of the FS mineral resource.

The Proponent's geologists developed the geological model used for the FS between March 2012 and January 2013. It incorporated separate models for geology (lithology), structure, alteration, sulphide mineralogy, grade shells, and bedrock and weathered surface model.

For the alteration model, the six alteration assemblages were consolidated into three principal categories: ammonium-bearing illite overprint, texture-destructive quartz-mica "sericitic," and potassic. Statistical comparisons of the modelled sericite and silica between gold and silver, respectively, demonstrate the relationships between mineralization and alteration. Similar comparisons also demonstrate the relationships between gold and logged sulphides, particularly pyrite and dendritic black sulphide (DBS) mineralization.

Four key mineral species were selected for modelling: pyrite, sphalerite, pyrrhotite, and DBS. Each species was reported as a mineral abundance percentage in a field that classified it as one of three styles: vein, disseminated, or selective replacement. It was found that the combination of pyrite and DBS had the strongest and most direct correlation to gold mineralization.

A grade shell domain was generated for gold within the mineralized Pyrite Shell to exclude some areas of very low grade. A second grade shell domain was created to constrain a high-silver / low-gold zone in the upper north area of the deposit that was mostly outside the Pyrite Shell.

A bedrock surface was modelled by creating profiles based on drill hole intercepts and generating a digital elevation model. Surfaces representing the base of the weathered oxide and oxide-sulphide transition zones were also generated and used to code the blocks.

The block model was created in Gemcom-Surpac Vision© software using a block size with dimensions of 12 m x 12 m x 12 m. This is an increase from the 10 m x 10 m x 10 m block size used in the Preliminary Economic Assessment (PEA). The 12 m bench height for the FS model was selected based on dilution, equipment productivity, and costs for an assumed production rate of 60,000 t/d.

Resource classifications used in this study conform to the following definitions from National Instrument 43-101. Blocks were assigned preliminary classifications based on drill hole spacing. Blocks falling within the 25 m x 25 m drill hole spacing pattern were assigned a tentative Measured classification. Blocks not meeting these conditions were classified as Indicated if they were within the area drilled with a 50 m x 50 m spacing. All other estimated blocks were assigned to the Inferred category.

For Measured mineral resources, blocks falling outside a 0.2 g/t Au equivalent grade shell were downgraded to Indicated because continuity of economic grades outside the grade shell cannot be demonstrated. Blocks falling within the high-grade silver grade shell were classified to the Indicated and Inferred categories using a nominal drill hole spacing of 50 m. A smoothing algorithm was used to remove isolated Measured blocks within areas of Indicated blocks, isolated Indicated blocks within areas of Measured, Indicated blocks within areas of Inferred, and isolated blocks of Inferred within areas of Indicated.

Gold equivalent values were calculated using variable metallurgical recoveries depending on the mineralization type. Mineralization types were assigned to oxide, transition, or sulphide depending on the oxidative state.

The Proponent has chosen a gold equivalent cutoff grade of 0.3 g/t to report the mineral resource estimate for stockpile material and a gold equivalent cutoff of 0.4 g/t for reporting direct processing mineral resources.

The mineral resource estimate is presented in **Table 5.1.3.1-2** and corresponds with the resource presented in **Section 2.2**.

***Table 5.1.3.1-2: Measured, Indicated, and Inferred Resources***

| Classification | Ore (kt) | Au (g/t) | In-Situ Au (kg) | In-Situ Au (koz) | Ag (g/t) | In-Situ Ag (kg) | In-Situ Ag (koz) |
|---|---|---|---|---|---|---|---|
| Measured | 144,844 | 0.888 | 128,632 | 4,136 | 5.246 | 759,919 | 24,432 |
| Indicated | 199,601 | 0.629 | 125,569 | 4,037 | 5.672 | 1,132,116 | 36,398 |
| Inferred (waste) | 2,691 | 0.516 | 1,388 | 45 | 3.760 | 10,118 | 325 |

### 5.1.3.1.8 Geochemistry

The metal leaching and acid rock drainage (ML/ARD) characterization report is included as **Appendix 5.1.3.1A**.

The ML/ARD assessment was conducted in accordance with both the *Policy for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia* (BC MEM, 1998) and the *Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials* (Price, 2009). This latter document is an update of the *Draft Guidelines and recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia* (Price, 1997). Additional best practices guidance came from the *Water and Air Monitoring Guidance Document for Mine Proponents and Operators* (BC Ministry of Environment, 2012) and the Global Acid Rock Drainage guide (GARD Guide, 2009).

Results of the characterization were used in the effects assessment for surface water quality (**Section 5.3.3**). The geochemical characterization was also used to support the design of mine water and mine water management.

The following features of the geology are relevant to the ML/ARD characterization:

- The main rock types are felsic to intermediate volcanic and volcaniclastic rocks;
- The deposit host rocks have been intensely hydrofractured and silicified. This intensive silicification has generally overprinted lithological units;
- Pyrite, pyrrhotite, and sphalerite are the most common metal sulphide minerals; and
- Calcite is a diagnostic feature of unmineralized andesite peripheral to the deposit.

Geochemical sampling for acid base accounting (ABA) and related parameters was conducted from 2011 to 2013 using exploration and geotechnical drill core to obtain overburden, waste rock, and ore samples. A dedicated 14-hole drilling program was completed in 2012 to obtain additional waste rock samples for ABA and metal analyses, and were peripheral to the south and west walls of the open pit. Tailings were obtained from the metallurgical testing program. Overburden samples were collected from a sonic drilling program and surface test pits in the open pit and Tailings Storage Facility (TSF) areas, and from surface grabs along the access road alignment in 2013. Tailings samples from various metallurgical tests were tested as part of the ML/ARD characterization. In total, over 900 waste rock, ore, overburden, and tailings samples were collected and analyzed for ML/ARD parameters.

Static tests used for characterization include optical and X-ray diffraction mineralogy, ABA, multi-element analysis after AR, shake flask extraction (SFE), and the net acid generation test. Kinetic tests provide information on the weathering and oxidation rates, including the relative rates of sulphide oxidation, and metal leaching (ML). A number of kinetic tests were completed for the Project, including humidity cells and leach column tests, and field test cells. Additionally, there were a number of Project-specific tests completed to answer specific questions related to the geochemical behaviour of waste rock and to guide management practices. This specific test work included oxygen consumption, acid buffering characteristic curve (ABCC), sequential net acid generation, kinetic net acid generation testing, acidic leachate pH neutralization experiments, and sequential extractions.

In addition, one meter core from most of the geological exploration program holes were sampled and analyzed (after aqua regia digestion) for metals by ICP-MS resulting in over 285,000 assays.

**Table 5.1.3.1-3** shows a summary of the extensive geochemistry testwork database for the Project.

Overburden was classified as non-potentially acid generating (NAG) based on ABA and NAG test results. All overburden samples from the open pit, plant, TSF, and access road area were classified as NAG based on ABA results and the net acid generation test. However, one sample from the overburden-bedrock interface had elevated sulphur and was classified as PAG, and three interface samples had an uncertain ARD classification. Except for material near the bedrock interface, overburden can be used for construction and reclamation purposes. Overburden near the interface will be tested and if found to be PAG or ML it will be managed like PAG waste rock.

Waste rock has low sulphur concentrations (median of 0.3% total sulphur) and low neutralization potential NP (median of 10 kg $CaCO_3$/t). Waste rock will be segregated and managed on the basis of neutralization potential ratio (NPR) and zinc concentrations. A detailed assessment of the waste rock by lithology and oxidation facies is included in the ML/ARD Characterization Report (**Appendix 5.1.3.1A**).

Pyrite and sphalerite were the most common sulphide minerals identified in waste rock samples. Calcite was the most commonly identified carbonate mineral for NAG 4 and NAG 5 samples and was also observed in NAG 3 material. Siderite was only identified in PAG1, PAG2, and NAG3 samples. Some of the waste rock had high concentrations of solid phase metals, most notably zinc and cadmium.

The ABA results showed that the waste rock had low sulphur concentrations; 88% of all samples had a total sulphur concentration less than 1.0%. The waste rock also had low NP and carbonate NP values. The median NP value for all samples was 10 kg $CaCO_3$/t and the median carbonate NP CNP was 4.2 kg $CaCO_3$/t.

***Table 5.1.3.1-3: Geochemistry Testwork Summary***

| Test | Laboratory | Number of Samples | | | | | |
|---|---|---|---|---|---|---|---|
| | | Exploration Samples | Waste Rock | Ore | Tailings | Overburden | |
| | | | | | | Open Pit/TSF/ Plant Site | Access Road |
| Acid Base Accounting | ALS | - | 890 | 72 | 12 | 76 | 19 |
| Multi-element Chemistry | ALS | 285,234 | 617 | 72 | 12 | 76 | 19 |
| Mineralogy/Petrography | UBC/ Vancouver Petrographics | - | 25 | 48 | - | 2 | - |
| Shake Flask Extraction | ALS | - | 58 | 8 | 5 | 14 | - |
| Net Acid Generation Test | ALS | - | 587 | 36 | 8 | 29 | - |
| Net Acid Generation Leachate | ALS | - | 78 | 7 | 5 | 5 | |
| ***Kinetic Tests*** | | | | | | | |
| Humidity Cells | ALS | - | 19 | 2 | 5 | - | - |
| Modified Humidity Cells | ALS | - | 3 | 1 | - | - | - |
| Saturated Columns | SGS-CEMI | - | 2 | - | - | - | - |
| Kinetic Field Bins | AMEC | - | 6 | 2 | - | - | - |
| ***Project Specific Tests*** | | | | | | | |
| Oxygen Consumption | EGi | - | 1 | - | - | - | - |
| Acid Buffering Characteristic Curve | EGi | - | 12 | - | - | - | - |
| Sequential Net Acid Generation | EGi | - | 4 | - | - | - | - |
| Kinetic Net Acid Generation | EGi | - | 6 | - | - | - | - |
| Humidity Cell pH Neutralization | ALS | - | 5 | 1 | - | - | - |
| Sequential Extraction | ALS | - | 10 | - | - | - | - |
| Adsorption Experiments | Lorax | - | 6 | | | | |
| Scanning Electron and Optical Microscopy | Lorax | - | 5 | | 2 | | |
| $SO_2$ Air/Cyanide Destruction | SGS | - | | | 23 | | |

**Note:** TSF = Tailings Storage Facility; UBC = University of British Columbia

***Table 5.1.3.1-4: Acid Rock Drainage Classification of Project Samples***

| Classification | NPR | Metal Content |
|---|---|---|
| PAG 1 | NPR ≤ 1 | - |
| PAG 2 | 1 > NPR ≤2 | - |
| NAG 3 | NPR > 2 | zinc ≥ 1,000 mg/kg |
| NAG 4 | NPR > 2 | 600 ≥ zinc < 1,000 mg/kg |
| NAG 5 | NPR > 2 | zinc < 600 mg/kg |

**Note**: mg/kg = milligram per kilogram; NAG = non-acid generating; NPR = neutralization potential ratio; PAG = potentially acid generating.

Sulphur content measured by inductively coupled plasma ICP analysis after aqua regia digestion was shown to be a good surrogate for total sulphur as determined by Leco furnace. Calcium NP can be used as a surrogate for NP, although it did result in the classification of approximately 4% of low zinc PAG1 and PAG2 samples as NAG4 or NAG5. A detailed investigation of these 39 samples showed that only 16 of the 39 misclassified samples were within the ultimate pit (2% or 16 of 890 samples). The humidity cell tests showed that all the PAG1 and some of the PAG2 samples were acid generating with little to no lag time. None of the NAG humidity cell tests had depressed leachate pH values. In general, cadmium, zinc, iron, and lead loads are higher in the tests with acidic pH values compared to those with neutral or alkaline values.

The results of the field bin tests were similar to those for the humidity cell tests, but typically had a longer lag time until acid generation. Metal loads from the sub-aqueous waste rock columns were significantly lower (often by an order of magnitude) than comparable humidity cell tests, due to oxygen-deficient conditions created by the water cover inhibiting sulphide mineral oxidation. Taken together, the results of kinetic testing indicate time until acid generation will be longer under field conditions than in laboratory testing, metal loads under neutral pH conditions are lower than under acidic conditions, and underwater storage of waste rock significantly reduced ML. Selenium and mercury were generally less than detection limit in all leaching tests and not expected to be a concern.

The pH neutralization experiments showed that metal loads in acidic humidity cell leachate can be significantly reduced by increasing to alkaline pH values through lime addition and co-precipitation or adsorption onto iron hydroxides. This suggests that adding acidic, metal-rich drainage from any on-land dumps, or from adding interstitial PAG waste rock water in the TSF to alkaline water generated during the milling process, would reduce metal concentrations. Nevertheless, drainage from the low-grade ore (LGO) stockpile and temporary ore stockpile will be neutralized by lime prior to addition to the TSF.

Ore samples are primarily PAG with high metal concentrations and low NP values.

A range of metallurgical test tailings samples were tested including whole ore leach (WOL) samples. The WOL tailings were PAG and had elevated solid phase concentrations of arsenic, cadmium, and zinc. Humidity cell testing results indicate that the WOL tailings tends to have lower metal loads than the heap leach tailings and similar loads to sulphide ore flotation tailings and the rougher flotation tailings. The W1OL tailings sample typically also had a lag time between the start of testing, development of slightly acidic leachate (pH less than 6.0) and the increase in metal loads. Given the similar loads between the rougher tailings and the WOL tailings, there would have to be very high removal of metal sulphides to produce ‘clean’ rougher tailings with low metal loads. Further metallurgical testing showed removal of sulphide minerals is not practical given the very high mass pulls to concentrate.

The WOL tailings are expected to be PAG with elevated metal concentrations in leachates if left exposed in a dry state for an extended period on a tailings beach. Results from the humidity cell test suggest a lag time of up to one year (based on lab conditions) with a longer period expected in the field until ML/ARD may occur in exposed, non-saturated conditions.

The ABA block model showed the overall zonation from PAG material towards the center of the ore body with an increase in NAG material towards the periphery. Most of the waste generated by mining will be PAG 1 and PAG 2 (53%). Overburden will comprise 13% of the total amount of waste and 33% of the waste rock is NAG3, NAG4, or NAG5. The block model showed that blocks of the same waste rock types tend to occur together and will be amenable to segregation during operations.

***Table 5.1.3.1-5: Waste Rock and Overburden Tonnages***

| Classification | NPR | Metal Content | Tonnage (Kt)* |
|---|---|---|---|
| PAG 1 | NPR ≤ 1 | - | 366,699+ |
| PAG 2 | 1 > NPR ≤2 | - | |
| NAG 3 | NPR > 2 | zinc ≥ 1,000 mg/kg | 79,335 |
| NAG 4 | NPR > 2 | 600 ≥ zinc < 1,000 mg/kg | 44,173 |
| NAG 5 | NPR > 2 | zinc < 600 mg/kg | 108,399 |
| Overburden | NAG | | 91,592 |

**Note:** mg/kg = milligram per kilogram; NAG = non-acid generating; NPR = neutralization potential ratio; PAG = potentially acid generating; * Tonnages from Norwest (2013), + only combined tonnage for PAG 1 and PAG 2 provided in FS.

The block model was also used to examine the waste rock types exposed in the ultimate open pit at the end of mining and after the pit lake is flooded. The flooding of the open pit reduces the exposed area of PAG1 and PAG2 waste rock from 32% of the ultimate pit walls to 16%, and reduces the area of the NAG3 waste rock from 11% to 5%. Most of the exposed high wall will be overburden and NAG4 and NAG5 waste rock. Therefore, the exposed ultimate high wall above the pit lake has limited potential for ML/ARD.

The geochemical characterization laboratory test results were used to develop loading source terms and predictive water quality models for several mine features. The results of testing and modelling were provided as input to the overall site water quality modelling efforts. The details of laboratory tests used to develop the source terms are provided in **Appendix 5.1.3.1A** Section 6.0,

Table 6-2 (low grade stockpile), Table 6-4 (temporary ore stockpile), Table 6-6 (combined East/West Dump),Table 6-11 (waste rock interstial water quality in the TSF), and Table 6-16 (open pit). All the testing and modelling results were used to support a series of ARD 'rules' to guide waste management during all phases of mining. In general, PAG and ML NAG (NAG3) waste rock will be permanently submerged in the TSF. NAG waste rock with low metal content will be stored in on-land waste rock dumps or used for construction. The best available material, typically NAG5, and overburden will be used for the Dam D downstream shell and the East Dump. Limited NAG4 will be used in the Dam D downstream shell. PAG WOL tailings will be kept saturated or covered as quickly as possible by fresh alkaline tailings during operations. All transition and sulphide tailings will be permanently submerged for closure. An oxide tailings may be used as a partial cover over the tailings beaches if testing early in the mine life verify its NAG and low ML characteristics. Tailings and waste rock interstitial water in the TSF will be separated from the supernatant by a layer of overburden placed at closure of the tailings facilities.

Predictive water quality models were developed to provide estimates for the drainage quality from the mine features:

- LGO stockpile;
- Temporary ore stockpile;
- PAG and NAG 3 waste rock interstitial water in the TSF;
- Combined East and West Dump;
- East Dump; and
- Open pit.

The East Dump model also assessed the impact of imperfect waste rock segregation on drainage quality. During operations, a drainage diversion will route East Dump drainage to the tailings storage facility. At closure a compacted overburden cover will be placed on the East Dump to reduce infiltration and facilitate reclamation. Operational monitoring results of East Dump drainage quality will be used to determine if the diversion can be removed during closure, allowing drainage to flow to Creek 661.

This work also assesses the impact of imperfect segregation of waste rock during mine operations. The East Dump was chosen since drainage could flow to Creek 661 while any drainage from the West Dump would flow to the tailings storage facility.

All water quality estimates were mass balance models and annual results were used as inputs to the overall Project water quality model (**Section 5.3.3**). The summary results of the predictive models are presented in **Appendix 5.1.3.1A**, Section 6.0, Table 6-3 (low grade stockpile), Table 6-5 (temporary ore stockpile), Table 6-9 (combined East/West Dump), Table 6-20 (East Dump), Table 6-21 (estimated worst case seepage quality), Table 6-13 (waste rock interstial water quality in the TSF), and Table 6-17 (open pit).

### 5.1.3.2 Soils and Terrain

#### 5.1.3.2.1 Introduction

This section presents a summary of the baseline conditions for the soils, terrain, and surficial geology resources of the Project. The detailed 2013 Soils, Terrain, and Surficial Geology Baseline Report (AMEC, 2013) is included in **Appendix 5.1.3.2A**. Figures presented in this baseline report include:

- Terrain maps for the proposed Project for the RSA and LSA for the mine footprint as well as the transmission line, access road, and freshwater supply pipeline (Annex 3 “Surficial Materials Map” of **Appendix 5.1.3.2A**);
- Soils maps identifying Soil Map Units (SMUs) for the entire study area (Annex 4 “Soil Map Units” of **Appendix 5.1.3.2A**);
- Reclamation suitability maps indicating suitability of reclamation material for the presented polygons (Annex 5 “Reclamation Suitability Rating Map” of **Appendix 5.1.3.2A**); and
- A terrain stability maps indicating areas of potential slope instability (Annex 6 “Terrain Stability Map” of **Appendix 5.1.3.2A**).

This section also provides descriptions and mapping of soils, terrain, and surficial geology. The baseline conditions are presented for each of the Project components including the proposed mine site, freshwater supply pipeline, airstrip, transmission line (including two re-route options), and access roads, within the Regional Study Area (RSA) and Local Study Areas (LSAs) (**Appendix 5.1.3.2A**). The results of recent field sampling programs conducted within the Project study area are also presented, as well as the description of reclamation suitability of the identified soil types, and the terrain stability of the local parent materials. The results were used in developing the Reclamation and Closure Plan for the Project. **Figure 5.1.3.2-1** shows the study areas for terrain and soils. A description of the Quality Assurance/Control program AMEC laboratories utilizes for the handling and analysis of the soil samples is presented in **Appendix 5.1.3.2B**.

#### 5.1.3.2.2 Methods

##### *5.1.3.2.2.1 Information Sources*

A comprehensive review of the existing biophysical information was conducted for familiarization with previous interpretations of the area. Existing information consists of two adjacent detailed soil survey reports (BC Department of Agriculture (BC DOA) (BC DOA, 1974) and BC Ministry of Environment (BC MOE) (Dawson, 1989)), which include descriptions of the surficial geology and physiography of the area, terrain and surficial geology maps (Plouffe et al., 2004), and available Geographic Information System (GIS) raster and vector data. Terrain mapping was conducted following the provincial mapping conventions outlined in Howes and Kenk (1997) and Resource Inventory Committee (RIC) (1996). Terrain mapping included the identification of parent material type, topographic form, and geomorphic processes. Soil moisture conditions were also mapped based on the Field Manual for Describing Terrestrial Ecosystems (BC Ministry of Forests (BC

MOF) and BC MOE, 1998). Terrain polygons were then assigned terrain stability ratings based on the Mapping and Assessing Terrain Stability Guidebook (BC MOF, 1999).

Map development for the soil resources was based on assigning soil associations to the delineated terrain polygons. Soil associations were derived from the Soils of the Nechako – Francois Lake Area soil survey (BC DOA, 1974) and Soils of the Prince George – McLeod Lake Area (Dawson, 1989). Soil associations based on soil orders, drainage, and physiographic regions were identified and presented on 1:125,000-scale maps.

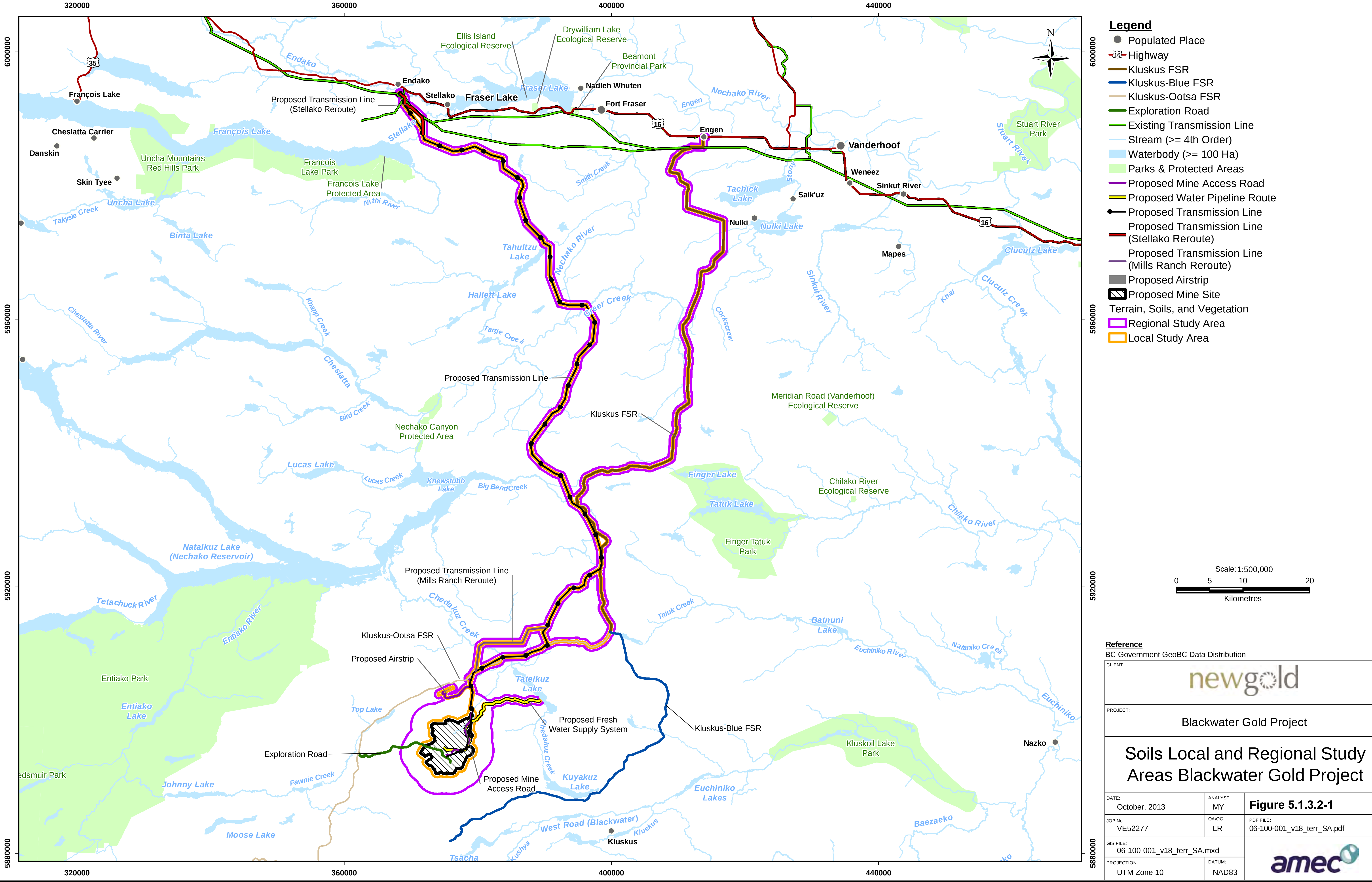
###### *5.1.3.2.2.2 Field Surveys*

Based on the Standards for Terrestrial Ecosystem Mapping in British Columbia (RIC, 1998), three different Survey Intensity Levels (SILs) are required to support the Project Application for an Environmental Assessment Certificate / Environmental Impact Statement (the Application). The mine site footprint requires the highest SIL, due to the high degree of disturbance expected in the area. The LSA requires a lower sampling intensity, based on the degree of disturbance expected in this area. A lower SIL was used in the RSA and linear features, where mostly indirect Project effects are anticipated. A single RSA encompassing all Project features was used in the assessment of the baseline conditions. **Section 4** provides complete definitions of Project boundaries.

The required SIL for each Project component is as follows:

- The mine site footprint requires an SIL1, or 76% to 100% of the identified polygons sampled, which equates to approximately 15 to 19 hectares (ha) per inspection when mapping at a scale of 1:20,000;
- The LSA requires an SIL2, or 51% to 75% of identified polygons sampled, which equates to approximately 20 ha to 29 ha per inspection at the same mapping scale; and
- The RSA for all features requires a reconnaissance level survey, with 0% to 4% of identified polygons having an inspection point, or 300 ha to 1,500 ha per inspection.

A total of 18 samples from eight inspection locations within the mine site LSA were analyzed for baseline soil metal elements. Values were then compared to the Canadian Council of Ministers of the Environment (CCME; 2007) and the BC *Contaminated Sites Regulation* (BC *CSR*) (Government of BC, 1996) guidelines to identify exceedances. The results of the trace metal analysis indicated that two sites had elevated arsenic levels higher in concentration than the guideline concentrations for soil identified in the Canadian Environmental Quality Guidelines (CEQG) for Residential/Parkland and Industrial areas (CCME, 2007). No exceedances to BC CSR guidelines were detected (**Appendix 5.1.3.2A**).




Reference
BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

# Soils Local and Regional Study Areas Blackwater Gold Project

| | | |
|---|---|---|
| DATE: October, 2013 | ANALYST: MY | Figure 5.1.3.2-1 |
| JOB No: VE52277 | QA/QC: LR | PDF FILE: 06-100-001_v18_terr_SA.pdf |
| GIS FILE: 06-100-001_v18_terr_SA.mxd | | |
| PROJECTION: UTM Zone 10 | DATUM: NAD83 | amec |

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##### *5.1.3.2.2.3 Interpretation of Aerial Photographs*

The interpretation of the Project utilized aerial photography, based on orthophotography collected in 2011 and LiDAR data collected in 2009. These data sources also covered the entire freshwater pipeline corridor, airstrip, and portions of the transmission line and access road. Within the mine site LSA, a 1 m gridded LiDAR Digital Elevation Model (DEM) hillshade was used as the primary interpretation method, supplemented by aerial photography. Both the LiDAR dataset and the orthophotography were applied to this baseline assessment to effectively capture the baseline terrain conditions at an approximate scale of 1:10,000.

##### *5.1.3.2.2.4 Baseline Soil and Terrain Map Development*

Based on the landform and surficial geology map developed for the mine site and linear features, a soil map was developed by assigning a soil association to each decile of the polygon on the terrain map. The combination of soil associations within each delineated terrain polygon is termed a Soil Map Unit (SMU), which is a “defined and named repetitive grouping of soil bodies occurring together in an individual and characteristic pattern over the soil landscape” (Gregorich et al., 2001). Refer to **Appendix 5.1.3.2A** for baseline soil and terrain maps for the Project boundaries.

##### *5.1.3.2.2.5 Soil Suitability for Reclamation*

The suitability of soils for reclamation purposes is derived by applying the criteria recommended by the BC Ministry of Energy (1998). These criteria are adapted from Soil Quality Criteria Relative to Disturbance and Reclamation (Alberta Soils Advisory Committee, 1987). The reclamation suitability of individual SMUs for the Project was based on the suitability rating of the dominant soil association for each unit, when the dominant association represents at least 60% of soils in that unit.

Soil associations of the Project study areas were rated for reclamation suitability as Good, Fair, Poor, or Unsuitable (Alberta Soils Advisory Committee, 1987). Soils are given a rating based on the most limiting condition of the profile. Due to the acidic nature of some forest soils, a different criterion was used in the determination of reclamation suitability based on soil reaction. Acid deposition studies (Ryan et al., 1986) indicated that a pH as low as 4.5 is not as detrimental to plant regeneration in comparison to more neutral soils of the eastern slopes on which the reclamation suitability guidelines were based. As such, the Good rating has been adjusted for this baseline report. Refer to **Appendix 5.1.3.2A** for the complete reclamation suitability criteria.

##### *5.1.3.2.2.6 Terrain Stability Ratings*

Terrain stability ratings were assigned to each terrain polygon using aerial photographs, satellite imagery, and LiDAR interpretation based on the criteria outlined in the Mapping and Assessing Terrain Stability Guidebook (BC MOF, 1999). This classification system is based on the parent material type, drainage conditions, slope gradient, and presence of geomorphic processes. A five-class terrain stability rating system, with ratings ranging from I to V (i.e., lowest to highest), was used for the Project.

#### 5.1.3.2.3 Baseline Terrain and Soil Conditions

##### *5.1.3.2.3.1 Description of Terrain Units*

The surficial sediments in the Project study areas consist of Quaternary and Holocene deposits. Morainal, glaciofluvial, and glaciolacustrine deposits are Quaternary in age, with deposition associated with the last glacial period. Holocene sediments comprise materials deposited since the end of glaciation to the present and include fluvial, colluvial, eolian, and organic (peat) deposits. **Table 5.1.3.2-1** is depicting soil depth and soil horizons.

***Table 5.1.3.2-1: Soil Depth and Soil Horizons***

| Soil Association | Dominant Order | Subgroups | Parent Material | Average and Range of Topsoil Thicknesses (cm) | Average and Range of Upper Subsoil Thickness (cm) | Soil Inspection Number |
|---|---|---|---|---|---|---|
| Alix | Brunisol | Orthic Dystric Brunisol | Glaciofluvial | LFH- 8 (1-33 cm);<br>Ae -7 (1-18 cm);<br>Ahe -8 (4-15 cm);<br>Of -40 (7-120 cm);<br>Om-117 (90-140 cm) | Bm-27 (7-63 cm) | G32, 11-7111, G34, G35, G70, SC19, SC10, SC11, G51, G52, SC5, G77, PB6, SC3<br><br>BW-8A, BW-40A, BW-41A, BW-43A, BW-34B, BW-118A, BW-116A, BW-115A, BW-113A, BW114A, BW-47A, BW-204A, BW-53A, BW-59A, BW-58A, BW-57A, BW-199A, BW-196A, BW-198A, BW-190A, BW-189A, BW-202A, BW-188A, BW-185A, BW-184A, BW-186A, BW-187A |
| Chief | Mesisol | Typic Mesisol<br>Terric Mesisol | Organics (FNPT) | Of- 92 (17-130 cm) | N/A | G37, G10, G78,V40, PB4, 11-7110, G31<br><br>BW-9A, BW-41A, BW-130A, BW-92A, BW-95, BW-202A, |
| Deserters | Luvisol | Brunisolic Gray Luvisol<br>Gleyed Brunisolic Gray Luvisol<br>Orthic Gray Luvisol | Morainal (basal till) | LFH – 5 (1-11 cm);<br>Ae – 7 (1-16 cm) | Bm -20 (6-40 cm) | SC9, SC8, SC7, SC1, SC2, SC13, SC12, SC10<br><br>BW-50A, BW-52A, BW-51A, BW-100B, BW-102A, BW-103A |
| Nithi | Brunisol | Orthic Dystric Brunisol<br>Orthic Eutric Brunisol | Fluvial | LHF- 7 (3-15 cm);<br>Ae- 5 (3-8 cm);<br>Ahg-38 (35-40 cm);<br>Of-37 (17-55 cm) | Bm-39 (11-62 cm) | G72, PB5, G49, SC18, SC20, G50, G36<br><br>BW-100A, BW-222A, BW-221A |
| Ormond | Brunisol | Orthic Dystric Brunisol<br>Lithic Regosol | Colluvium/bedrock | LFH-5 (2-11 cm);<br>Ae- 8 (2-19 cm) | Bm-28 (12-51 cm) | G27, SC22, G45, G46, G47, G48, SC17, PB7, G33<br><br>BW-20A, BW-44A, BW-215A, BW-111A, BW-19A |
| Pinkut | Brunisol | Orthic Eutric Brunisol | Colluvium/till | n/a | n/a | n/a |

| Soil Association | Dominant Order | Subgroups | Parent Material | Average and Range of Topsoil Thicknesses (cm) | Average and Range of Upper Subsoil Thickness (cm) | Soil Inspection Number |
|---|---|---|---|---|---|---|
| | | Orthic Dystric Brunisol | | | | |
| Twain | Podzol | Orthic Humo-Ferric Podzol<br>Brunisolic Gray Luvisol<br>Gleyed Orthic Humo-Ferric Podzol | Morainal (basal till) | LFH- 8 (2-18 cm);<br>Ae- 9 (2-21 cm);<br>Ah- 8 (4-11 cm);<br>Of- 55 (9-130 cm) | Bm- 27 (8-62 cm);<br>Bg- 40 (19-50 cm);<br>Bt- 20 (14-27 cm) | G26, G69, G81, SC14, PB4, PB3, G30, G29, SC6, SC16, G43, SC25, SC24, G44, S23, PB2 SC15,<br><br>BW-21A, , BW-213A, BW-156A, BW-160A, BW-225A, BW-167A, BW-168A, BW-175A, BW-176A, BW-46A, BW-22A, BW-181A, BW-158A, BW-36A, BW-31A, BW-37A, BW-141A, BW-28A, BW-29A, BW-30A, BW-38A, BW-39A, BW-135A, BW-133A, BW-132A, BW-138A, BW-139A, BW-147A, BW-148A, BW-150A, BW-129A, BW-130A, BW-127A, BW-119A, BW-120A, BW-123A, BW-122A, BW-124A, BW-125A, BW-121A, BW-220A, BW-218A, BW-219A, BW-117A, BW-112A, BW-110A, BW-106A, BW-107, BW-108, BW-9A, BW-97A, BW-98A, BW-56A, BW-55A, BW-54A, BW-208A, BW-207A, BW-209A, BW-206A, BW-205A, BW-210A, BW-211A, BW-212A, BW-204A, |
| **Non-Soil Units** | | | | | | |
| Disturbed land | DL | -- | Anthropogenically modified parent materials | n/a | n/a | n/a |
| Exposed bedrock | R | -- | Local bedrock exposed in-situ | n/a | n/a | n/a |
| Water | LA | -- | Open water bodies (lakes, ponds, streams) | n/a | n/a | n/a |

**Note:** cm = centimetre; n/a = not applicable

##### *5.1.3.2.3.2 Description of Soil Units*

Provincial soil associations are defined in the adjacent soils survey reports. Localized conditions may exist that differ slightly due to variations in parent materials or local climatic conditions. Based on site-specific information collected in the Project study areas, the following soil associations are applicable.

**Table 5.1.3.2-2** presents a summary of the soil associations identified within the Project study area, including the mine site and all linear features.

***Table 5.1.3.2-2: Summary of Soil Associations in the Project Study Area***

| Soil Association | Dominant Order | Subgroups | Parent Material |
|---|---|---|---|
| Alix | Brunisol | Orthic Dystric Brunisol | Glaciofluvial |
| Barrett | Luvisol | Orthic Gray Luvisol<br>Gleyed Orthic Gray Luvisol<br>Brunisolic Gray Luvisol | Morainal (Basal Till) |
| Berman | Luvisol | Orthic Gray Luvisol<br>Gleyed Orthic Gray Luvisol<br>Gleysols | Glaciolacustrine |
| Chief | Mesisol | Typic Mesisol<br>Terric Mesisol | Organics (FNPT) |
| Deserters | Luvisol | Brunisolic Gray Luvisol<br>Gleyed Brunisolic Gray Luvisol<br>Orthic Gray Luvisol | Morainal (Basal Till) |
| Knewstubb | Brunisol | Orthic Dystric Brunisol<br>Orthic Eutric Brunisol | Glaciolacustrine |
| Moxley | Mesisol | Typic Mesisol<br>Terric Mesisol | Organics (SPPT) |
| Nechako | Luvisol | Orthic Gray Luvisol<br>Gleyed Gray Luvisol | Fluvial |
| Nithi | Brunisol | Orthic Dystric Brunisol<br>Orthic Eutric Brunisol | Fluvial |
| Ormond | Brunisol | Orthic Dystric Brunisol<br>Lithic Regosol | Colluvium/Bedrock |
| Pinkut | Brunisol | Orthic Eutric Brunisol<br>Orthic Dystric Brunisol | Colluvium/Till |
| Twain | Podzol | Orthic Humo-Ferric Podzol<br>Brunisolic Gray Luvisol<br>Gleyed Orthic Humo-Ferric Podzol | Morainal (Basal Till) |
| Vanderhoof | Luvisol | Orthic Gray Luvisol<br>Gleyed Orthic Gray Luvisol<br>Gleysols | Glaciolacustrine |
| ***Non-Soil Units*** | | | |
| Disturbed Land | DL | - | Anthropogenically Modified Parent Materials |

| Soil Association | Dominant Order | Subgroups | Parent Material |
|---|---|---|---|
| Exposed Bedrock | R | - | Local Bedrock Exposed In Situ |
| Water | LA | - | Open Waterbodies (Lakes, Ponds, Streams) |

**Note**: DL = Disturbed Land; R = Bedrock Outcropping; LA = Open Water; FNPT = Fen Peat; SPPT = Sphagnum Peat

### *5.1.3.2.3.2.1 Summary of Baseline Conditions for Project Components*

The following sections present soil and terrain information for each Project component. These sections are a summary of the more detailed descriptions presented in **Appendix 5.1.3.2A**. Included are soil and terrain maps long with soil chemical and physical analytical data.

#### 5.1.3.2.3.2.1.1 Summary of Terrain and Soil Baseline Conditions for the RSA

The baseline surficial geology of the RSA is dominated by bedrock- and sediment-controlled, moderately fine- to coarse-textured morainal deposits, accounting for 54% of the area. Approximately 18% of the RSA is classified as glaciofluvial sediments, with another 8% consisting of glaciolacustrine deposits. Approximately 3% of the RSA is classified as fluvial deposits. These deposits are interspersed throughout the RSA, concentrated in and around the Davidson Creek drainage system. Bedrock-controlled slopes and relatively shallow surficial deposits occupy the western portion of the RSA near the mine site, where the landscape is dominated by hummocky to mountainous terrain, with steeper slope gradients. Colluvial deposits are more common in this area and account for 5% of the RSA, with bedrock outcrops in less than 1% of the RSA. Approximately 8% of the RSA area is classified as organic accumulations.

The mine site RSA is dominated by mineral soils, mostly of the Brunisolic, Luvisolic, and Podzolic soil orders. Deserters, Alix, and Twain are the dominant soil associations. The Chief and Moxley organic soil associations occupy approximately 8% of the RSA. The transitions from a colluvial parent material to morainal- or glaciofluvial-derived SMUs commonly occur over short distances and with little change in relief. As such, SMUs may contain a combination of contrasting soil conditions. Open waterbodies account for less than 1% in the RSA and are associated with organic soils.

When identifying the dominant reclamation suitability rating for each delineation, the Fair rating is the most dominant rating within the RSA at 66%. This corresponds to the high percentage of Deserters, Alix, and Berman soil associations mapped within the RSA. The Poor rating accounts for 14% of the RSA associated with the Twain soil association, and the Good rating accounts for 9% of the RSA. The Unsuitable rating accounts for 1% of the RSA defined as mostly esker material. The Organic rating applies to 8% of the RSA, while Not Rated (NR) accounts for 3%.

Terrain stability within the RSA is generally rated as Stable, and Class I, II, and III stability ratings are identified for 93% of the RSA. Potentially unstable Class IV slopes occupy 5% of the RSA, while unstable Class V slopes associated with steep slopes and over-steepened fluvial channels account for less than 1% of the RSA.

#### 5.1.3.2.3.2.1.2 Summary of Terrain and Soil Baseline Conditions for the Mine Site LSA

The baseline surficial geology of this LSA is dominated by morainal and glaciofluvial sediments, accounting for 75% of the area. Colluvial materials account for another 11%, and active and inactive fluvial material account for 7% of the LSA. Steeply incised channels running west to east through the LSA contain coarse-textured terraces, and high relief slopes account for the majority of colluvial deposits for the LSA at 11%. Organic deposits account for minor areas in the LSA (4%), and are located in well-defined depressional areas.

The dominant soil associations in the LSA are Twain, Alix, Deserters, and Ormond, which combined account for 82% of the LSA. Brunisolic, Luvisolic, and Podzolic are the modal soil orders associated with the soil associations. Minor areas of the Nithi soil association are found in association with fluvial channels and terraces, and account for 7% of the LSA. Approximately 4% of the LSA is occupied by organic Chief and Moxley associations surrounding the local waterbodies.

Reclamation suitability of the soils within the LSA is considered Fair to Poor. Morainal and glaciofluvial sediments are rated as Fair as a result of the low soil reaction (pH), coarse textures of the material, and high coarse fragment content. Soils in the LSA contain high levels of acidity, with pH values of around 4. Reclamation suitability was adjusted to reflect the natural state of these soils and the tolerances of the natural vegetation of the area.

Terrain stability within the LSA is generally rated as Stable, with Class I and II slopes occupying 84% of the LSA. Potentially unstable and unstable terrains combined occupy 5% of the LSA and are commonly associated with over-steepened fluvial channels and high relief areas. This rating is based on the high slope gradients, loose nature of the parent material, and presence of existing instability.

#### 5.1.3.2.3.2.1.3 Summary of Terrain and Soil Baseline Conditions for the Freshwater Supply Pipeline LSA

The baseline surficial geology of this LSA is dominated by sediment-controlled, moderately fine to moderately coarse-textured morainal deposits, accounting for 56% of the area. Approximately 35% of the LSA is classified as moderately coarse-textured glaciofluvial material. Fluvial deposits account for 2% of the LSA, and are associated with low-lying wetland areas, where organic accumulations account for 7% of the freshwater supply pipeline LSA. This LSA is dominated by mineral soils, mostly of the Luvisolic and Brunisolic soil orders. Deserters and Alix are the dominant soil associations, with minor areas of Nithi fluvial association. The Chief and Moxley organic soil associations combined occupy approximately 7% of the LSA. Open waterbodies account for less than 1% of the LSA, and are associated with organic soils. The Fair rating is the most dominant reclamation suitability rating for a polygon within the LSA at 93%. The Good rating accounts for 2% of the LSA, and no soils are rated as Poor or Unsuitable within the freshwater supply pipeline LSA. Terrain stability within the LSA is generally rated as Stable, and Class I, II, and III stability ratings are identified for 99% of the LSA. No potentially unstable Class IV or V slopes were identified in the LSA.

###### 5.1.3.2.3.2.1.4 Summary of Terrain and Soil Baseline Conditions in the Airstrip LSA

The baseline surficial geology of this LSA is dominated by sediment-controlled, moderately coarse to coarse-textured morainal deposits, accounting for 44% of the area. Approximately 36% of the LSA is classified as moderately fine to moderately coarse-textured morainal material. Fluvial deposits account for 3% of the LSA and are associated with low-lying wetland areas, where organic accumulations account for 7% of the LSA. The airstrip LSA is dominated by mineral soils, mostly of the Luvisolic and Brunisolic soil orders. Alix and Deserters are the dominant soil associations, with minor areas of colluvial Ormond, Nechako, and Nithi fluvial associations. The Chief and Moxley organic soil associations combined occupy approximately 7% of the LSA. The Fair rating is the most dominant reclamation suitability rating for a polygon within the LSA at 86%. The Good rating accounts for less than 1% of the LSA, and no soils are rated as Poor. Unsuitable soils account for 1% of the LSA. Terrain stability within the LSA is generally rated as Stable, and Class I, II, and III stability ratings are identified for 85% of the LSA. Approximately 8% of the LSA consists of potentially unstable Class IV slopes, while no Class V slopes were identified in the LSA.

###### 5.1.3.2.3.2.1.5 Summary of Terrain and Soil Baseline Conditions in the Transmission Line LSA

The baseline surficial geology of this LSA is dominated by bedrock- and sediment-controlled, moderately fine- to moderately coarse-textured morainal deposits, accounting for 66% of the area. Approximately 11% of the LSA is classified as glaciofluvial material, with an additional 8% identified as glaciolacustrine sediments. These glaciolacustrine deposits are concentrated to the east of Knewstubb Lake and are associated with eolian deposits that account for 5% of the LSA. Bedrock-controlled slopes and relatively shallow surficial deposits occupy the portions of the LSA where the corridor crosses the Nechako Range, and the landscape is dominated by hummocky to mountainous terrain, with steeper slope gradients. Colluvial deposits are more common in this area and account for 2% of the LSA. Equal proportions of fluvial and organic deposits are present within the LSA, each accounting for 4% of the area. Deserters, Twain, Alix, and Barrett are the dominant soil associations in the LSA, with minor areas of Ormond and Pinkut colluvial soils and Nechako and Nithi fluvial associations. The Chief and Moxley soil associations occupy approximately 4% of the LSA.

The Fair rating is the most dominant reclamation suitability rating for a polygon within the LSA at 64%. The Good rating accounts for 20% of the LSA, and the Poor rating accounts for 9%. Terrain stability within the RSA is generally rated as Stable, and Class I, II, and III stability ratings are identified for 90% of the LSA. Potentially unstable Class IV and unstable Class V slopes occupy more than 4% of the LSA.

###### 5.1.3.2.3.2.1.6 Summary of Terrain and Soil Baseline Conditions in the Mills Ranch Transmission Line LSA

The baseline surficial geology of this LSA is dominated by bedrock- and sediment-controlled, moderately fine- to moderately coarse-textured morainal deposits, accounting for 66% of the area.

Approximately 17% of the LSA is classified as glaciofluvial material, with an additional 5% identified as fluvial sediments. Organic deposits are relatively common within the LSA, accounting for 8% of the area. Deserters and Alix are the dominant soil associations in the LSA, with minor areas of Nithi and Berman soil associations. The Chief soil association occupies approximately 8% of the LSA.

The Fair rating is the most dominant reclamation suitability rating for a polygon within the RSA at 77%. The Good rating accounts for 5% of the LSA, and the Unsuitable rating accounts for 12%. Esker formations with high coarse fragment content received the Unsuitable rating for reclamation material. Terrain stability within the LSA is generally rated as Stable, and Class I, II, and III stability ratings are identified for 96% of the LSA. Potentially unstable Class IV slopes occupy 3% of the LSA, and no unstable Class V slopes were identified within the LSA area.

###### 5.1.3.2.3.2.1.7 Summary of Terrain and Soil Baseline Conditions in the Stellako Transmission Line LSA

The baseline surficial geology of this LSA is dominated by bedrock- and sediment-controlled, moderately fine- to moderately coarse-textured morainal deposits, accounting for 34% of the area. Approximately 21% of the LSA is classified as glaciofluvial material, with an additional 28% identified as glaciolacustrine sediments. Colluvial deposits are more common in areas where steep slope gradients are identified and account for 6% of the LSA. Equal proportions of colluvial and organic deposits are present within the LSA, each accounting for 6% of the area. Berman, Deserters, and Alix are the dominant soil associations in the LSA, with minor areas of Ormond and Barrett soils. The Chief and Moxley soil associations occupy approximately 6% of the LSA.

The Fair rating is the most dominant reclamation suitability rating for a polygon within the LSA at 83%. The Good rating accounts for 6% of the LSA, and the Organic rating accounts for 11%. Terrain stability within the LSA is generally rated as Stable, and Class I, II, and III stability ratings are identified for 98% of the LSA. Potentially unstable Class IV slopes occupy 1% of the LSA, and no unstable Class V slopes were identified within the LSA area.

###### 5.1.3.2.3.2.1.8 Summary of Terrain and Soil Baseline Conditions in the Access Route LSA

The majority of the proposed access route utilizes the existing Kluskus Forestry Service Road (FSR) north of the mine site towards Vanderhoof. Access from the Kluskus FSR to the proposed mine site will be provided by a new mine access road. The baseline surficial geology of this LSA is dominated by bedrock- and sediment-controlled, moderately fine- to moderately coarse textured morainal deposits, accounting for 33% of the area. Approximately 27% of the LSA is classified as glaciofluvial material, with an additional 15% identified as glaciolacustrine sediments. Colluvial deposits are uncommon and account for 1% of the LSA. Organic deposits are common within the LSA, accounting for 7% of the area. Fluvial sediments are less common and account for 2% of the area. Approximately 15% of the LSA is rated as Disturbed Land, which includes existing access roads and borrow sites. Alix, Deserters, Barrett, and Berman are the dominant soil associations, with minor areas of Vanderhoof, Twain, and Nithi associations. The Chief and Moxley soil associations occupy approximately 7% of the LSA.

The Fair rating is the most dominant reclamation suitability rating for a polygon within the RSA at 62%. This corresponds to the high percentage of Alix and Deserters soil associations mapped within the LSA. The Good rating accounts for 13% of the LSA, and the Poor rating accounts for 4%. Terrain stability within the LSA is generally rated as Stable, and Class I, II, and III stability ratings are identified for 85% of the LSA. The remaining 15% of the LSA is NR due to existing disturbance. Potentially unstable Class IV and unstable Class V slopes were not identified within the LSA.

5.1.3.2.3.2.1.9 Summary of Terrain and Soil Baseline Conditions in the Mine Access Road LSA

The proposed mine access road will be approximately 5 km long and originate from the existing Kluskus FSR to the east end of the mine site. The baseline surficial geology of the mine access road LSA is dominated by sediment-controlled, moderately fine- to moderately coarse-textured morainal deposits, accounting for 79% of the area. Approximately 14% of the LSA is classified as glaciofluvial material. Organic deposits are not common within the LSA, accounting for 3% of the area. Fluvial sediments are also not common and account for 2% of the area. Approximately 2% of the LSA is rated as Disturbed Land, which includes existing access roads. Alix and Deserters are the dominant soil associations, with minor areas of Nithi, Nechako, and Barrett associations. The Chief and Moxley soil associations occupy approximately 3% of the LSA.

The Fair rating is the most dominant reclamation suitability rating for a polygon within the LSA at 95%. This corresponds to the high percentage of Alix and Deserters soil associations mapped within the LSA. The Good rating accounts for 1% of the LSA, and no Poor ratings were identified. Terrain stability within the LSA is generally rated as Stable, and Class I, II, and III stability ratings are identified for 98% of the LSA. The remaining 2% of the LSA is NR due to existing disturbance. Potentially unstable Class IV and unstable Class V slopes were not identified within the LSA.

## 5.1.3.3 Vegetation

### 5.1.3.3.1 Introduction

This section presents the baseline vegetation condition for upland vegetation resources of the Project. The baseline discussion provides detailed descriptions and mapping of upland vegetation. The baseline conditions are presented for each of the Project components including the proposed mine site, mine site access road, freshwater supply system (water intake, pipeline, and freshwater reservoir), airstrip, transmission line (including two re-route options—Mills Ranch and Stellako), and existing Kluskus FSR.

The study areas for vegetation are presented in **Figure 5.1.3.3-1**. The AIR describes the LSA as follows (**Table 4.3-1** of **Section 4**):

- Mine site: 500 m from the proposed Project mine site boundary; and
- Transmission line, mine access road, airstrip, freshwater supply pipeline, and Kluskus FSR: 100 m beyond the proposed linear component boundary.

The rationale in the AIR for the LSA is as follows (**Table 4.3-1** of **Section 4**):

- Includes the entire mine site where soil and vegetation will be removed and considers a buffer to take into account potential edge effects and particulate matter deposition; and
- Includes entire linear components and a buffer (50 m) to take into account potential edge effects and particulate matter deposition. The buffer for the linear components is smaller given that vegetation or soil removal will be conducted in lower quantities.

The LSAs of the mine site access road, freshwater supply system, airstrip, transmission line, and Kluskus FSR extend 100 metres (m) beyond their corridors in either direction. The corridor is the area defined as the right-of-way (ROW) plus a 50 m buffer. The ROW for all linear features is 20m with the exception of the transmission line, which is 40 m; the freshwater supply line and airstrip access is 10m; and the airstrip is 200 m corridor (100 m corridor with 50 m buffer each saide). The mine site LSA includes the proposed footprint and a buffer zone of 500 m around the proposed mine site. The combined total area of all LSAs is approximately 14,000 ha. The various LSAs are meant to circumscribe the boundaries of the effects of the Project components, including a buffer zone. The LSAs encapsulate any predicted contiguous effects from activities that may cause disturbance to the natural vegetation surrounding the proposed mine footprint and other Project components.

The AIR describes the RSA as follows (**Table 4.3-1** of **Section 4**):

- Mine site: 3,000 m from the proposed Project mine site boundary; and
- Transmission line, mine access road, airstrip, freshwater supply pipeline and Kluskus FSR: 500 m beyond their proposed linear component boundary.

The rationale in the AIR for the RSA is as follows (**Table 4.3-1** of **Section 4**):

- Considers an additional buffer around the LSA to take into account potential interactions with other projects or activities.

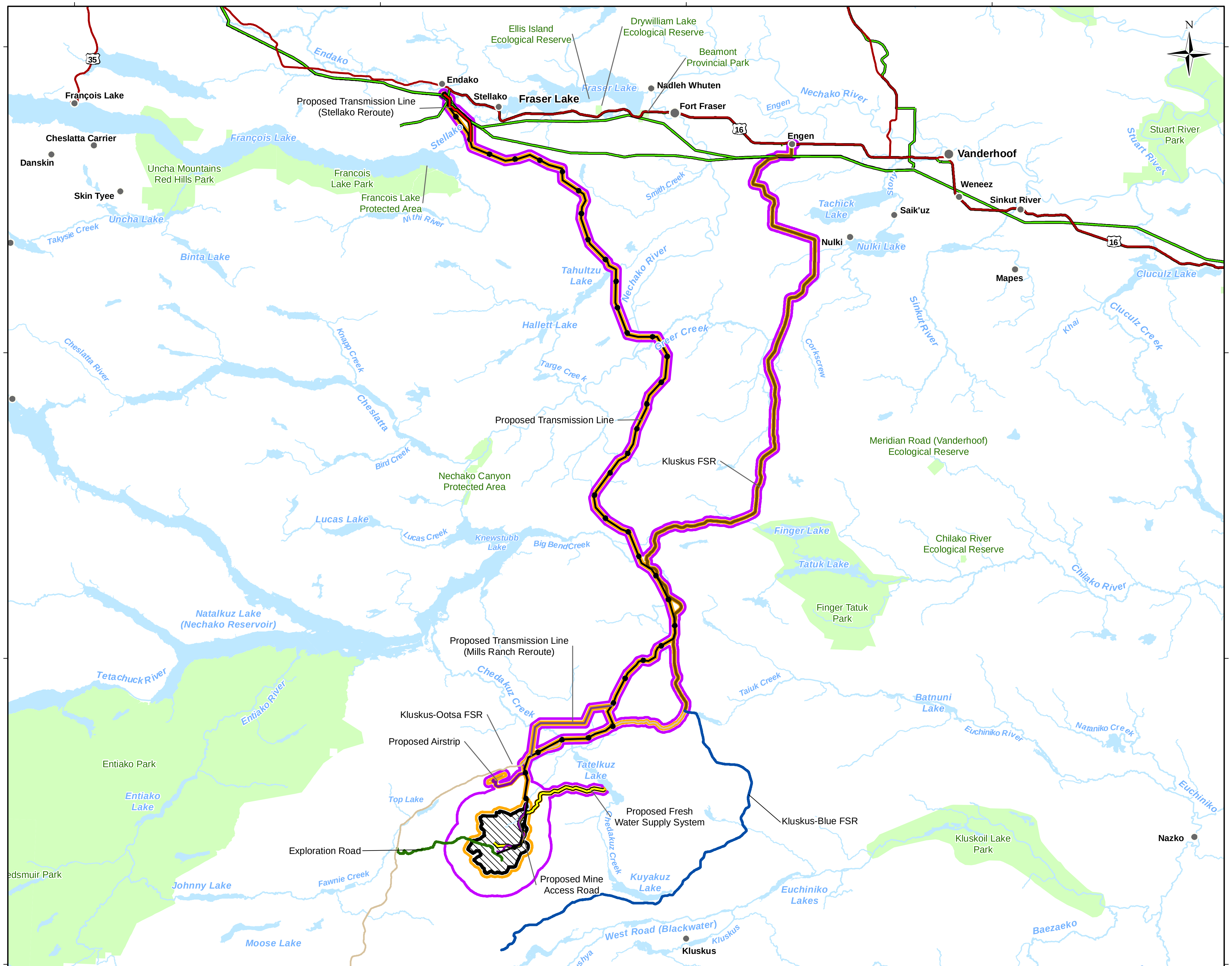
The RSA is one continuous boundary surrounding all of the proposed features of the Project and totals approximately 31,000 ha exclusive of the LSA. The RSA is defined as a 3 kilometre (km) buffer around the proposed mine site. The mine site access road, freshwater supply system, airstrip, transmission line and Kluskus FSR RSAs are defined using a 1 km boundary around their corridors.

The results of field sampling programs and ecosystem mapping within the Project study areas are presented in this section and in the Vegetation Baseline Report **Appendix 5.1.3.3A**.

The wetland baseline regarding wetland ecosystems and function is a separate report and is presented in **Appendix 5.3.7A**. Metal analysis and bioaccumulation of metals in plant tissue is discussed in the Environmental Health Baseline (AMEC, 2013) and is presented in **Appendix 9.1A**. Invasive Plant baseline conditions will be presented in the baseline report and management strategies will be presented in **Section 12.2**, Environmental Management Plans.

##### 5.1.3.3.2 Scope of Work

The scope of the vegetation program includes field surveying all project components for the purpose of ecosystem classification; ground-truthing for ecosystem mapping; documenting plant species and ecosystems at risk; and identifying invasive plants. Surveys were required to classify and describe the ecosystems occurring in the study areas. This data were used to interpret aerial photography and satellite imagery. Final ecosystem maps were generated and can be used to interpret the distribution of ecosystems, ecosystems at risk, sensitive ecosystems, and potential traditional use plant areas.




**Legend**

- Populated Place
- Highway
- Kluskus FSR
- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Exploration Road
- Existing Transmission Line
- Stream (>= 4th Order)
- Waterbody (>= 100 Ha)
- Parks & Protected Areas
- Proposed Mine Access Road
- Proposed Water Pipeline Route
- Proposed Transmission Line
- Proposed Transmission Line (Stellako Reroute)
- Proposed Transmission Line (Mills Ranch Reroute)
- Proposed Airstrip
- Proposed Mine Site

Terrain, Soils, and Vegetation

- Regional Study Area
- Local Study Area

Scale: 1:500,000

0 5 10 20

Kilometres

**Reference**

BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Vegetation Local and Regional Study Areas Blackwater Gold Project

| DATE: October, 2013 | ANALYST: MY | **Figure 5.1.3.3-1** |
|---|---|---|
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| GIS FILE: 06-100-001_v18_terr_SA.mxd | | |
| PROJECTION: UTM Zone 10 | DATUM: NAD83 | amec |

#### 5.1.3.3.3 Methods

##### *5.1.3.3.3.1 Information Sources*

A review of existing information was conducted and primary information sources are listed below. Field surveys took place in July 2011, August 2011, July 2012, and July 2013. Primary information sources include:

- BC Species and Ecosystem Explorer (BC Conservation Data Centre (BC CDC), 2013);
- E-Flora BC (Klinkenberg, 2013);
- Predictive ecosystem mapping (Timberline 2001a, 2001b);
- Biogeoclimatic Line Work Version 8 (Data BC, 2012);
- Endangered Species And Ecosystems – Non-Confidential Occurrences (DataBC, 2013a);
- Endangered Species and Ecosystems – Masked (Confidential) Occurrences (DataBC, 2013b);
- Digital Terrain Resource Information Management (DataBC, 2013c);
- Vanderhoof Land and Resource Management Plan (BC Ministry of Environment, Lands and Parks (BC MELP), 1997);
- Ecological Reports Catalogue (BC MOE, 2013a);
- Cross-Linked Information Resources (BC MOE, 2013b);
- The Invasive Alien Plant Program (IAPP) (BC Ministry of Forests, Lands and Natural Resource Operations (BC MFLNRO), 2013a);
- Vegetation resource inventory (BC MFLNRO, 2013b);
- Field Guide to Noxious and Other Selected Weeds of BC (BC Ministry of Agriculture, 2002);
- Northwest Invasive Plant Council (NWIPC) 2012 Strategic Plan and Plant Profiles (Northwest Invasive Plant Council, 2012); and
- Cariboo Chilcotin Coast Invasive Plant Committee (2012) Regional Strategic Plan.

##### *5.1.3.3.3.2 Field Surveys*

Ecosystem mapping was based on the Standards for Terrestrial Ecosystem Mapping in British Columbia (RIC, 1998), data collection was based on the principles and methods outlined by the Field Manual for Describing Terrestrial Ecosystems (MOFR and BC MOE, 2010), and Ecosystem classification was based on the Land Management Handbook 24 (LMH) (DeLong et al., 1993).

Three SIL relating to the percent polygons inspected, were applied: 3, 5 and reconnaissance (RIC, 1998).

The mine site, due to a higher degree of anticipated disturbance, required a SIL of 3 (25 % to 50% polygon inspections). For linear components, such as the freshwater supply system and transmission line where less disturbance was anticipated, the SIL was 5 (5 % to 15 % polygon inspections). For the existing Kluskus FSR, where limited disturbance was anticipated with the exception of a possible re-alignment upgrade, reconnaissance (0% to 4% polygons inspections) level survey was completed. The ratio of Full: Ground: Visual plots SIL 3 and 5 is 5:20:75 and for reconnaissance level SIL is 0:25:75; however, emphasis was placed on Ground plots as they provide the best level of data needed to ground-truth the mapping.

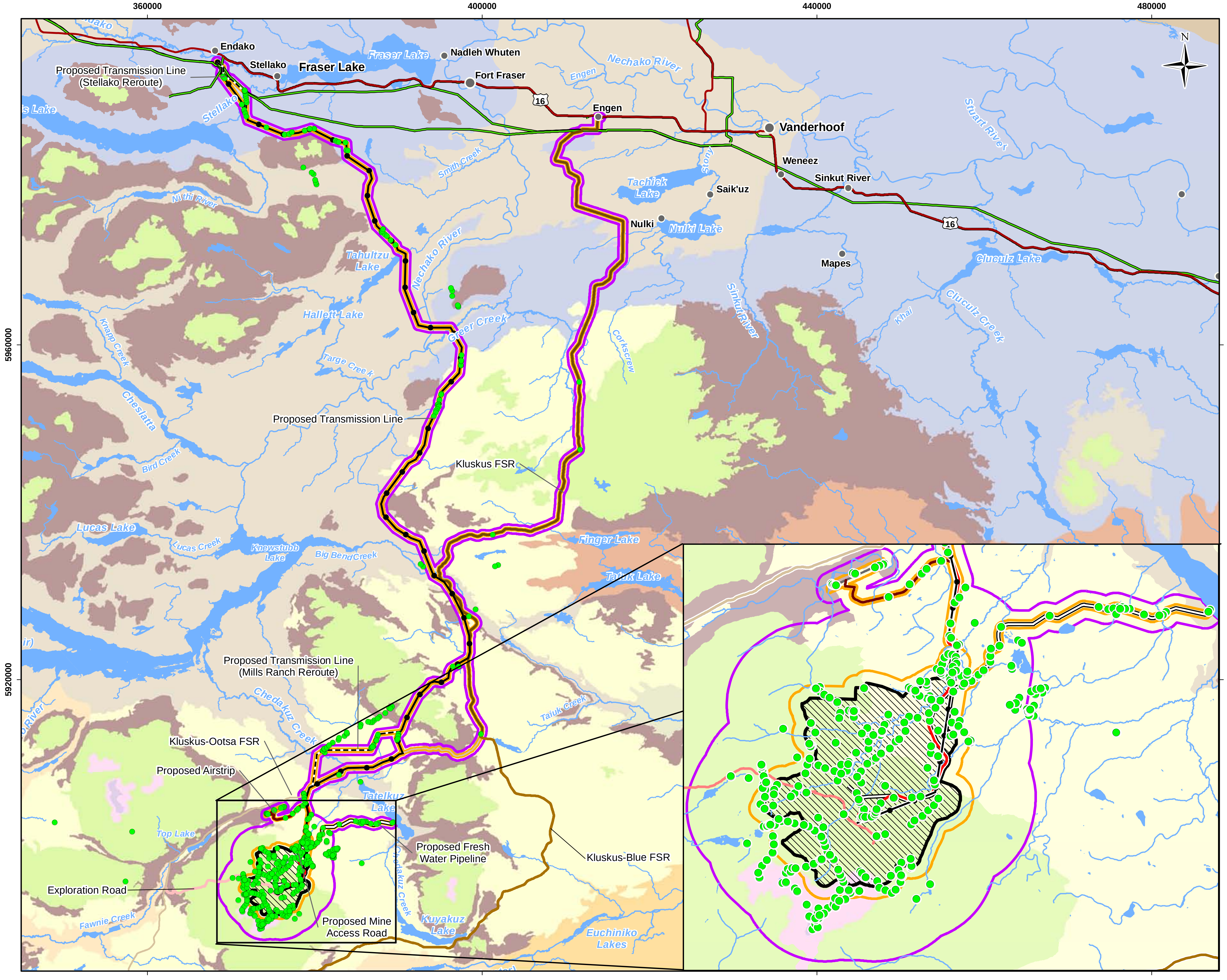
Six field surveys were conducted over a three-year period (2011–2013). The data were used to classify and describe ecosystems and to survey for plant species and ecosystems at risk and for invasive plant species. A preliminary sampling plan was developed before the commencement of fieldwork each year. Survey plots completed in 2011 focused on data from the mine site LSA. The subsequent field survey in 2012 focused on data from the proposed freshwater supply system and transmission line. The final field survey in 2013 focused on data from the mine site, proposed mine access road, airstrip, and transmission line. **Figure 5.1.3.3-2** shows the TEM and plant species at risk survey locations.

##### *5.1.3.3.3.3 Mapping*

Given the complexity and extent of the Project area, ecosystem mapping methods varied depending on the Project component. The mine site, mine site access road, freshwater supply system, and airstrip were mapped using a standard TEM (RIC, 1998) approach based on bioterrain and three-dimensional (3D) aerial photograph interpretation employing 2011 aerial photography and LiDAR (Light Detection and Ranging). The transmission line was mapped using a modified TEM approach as follows: The bioterrain mapping portion utilized hard copy aerial photography from 1953 and 2000 in combination with satellite imagery to delineate bioterrain features. The ecosystem polygons were delineated based on the bioterrain polygons in combination with 2D 2012 satellite imagery and a slope model. The Kluskus FSR was mapped using the existing Predictive Ecosystem Mapping (PEM), Vegetation Resource Inventory (VRI), and combination of satellite imagery and web-based photograph interpretation. Ecosystem mapping was completed at a scale of 1:5,000 for all Project components with the exception of the existing Kluskus FSR, which was based on 1:20,000 scale PEM.

##### *5.1.3.3.3.4 Ecosystem Distribution*

The final ecosystem map shows the distribution of ecosystems across the Project area. The ecosystem map is composed of polygons, which contain up to three ecosystem units. Each unit is represented by a decile to denote the percent area within that polygon. Applying ArcMap and programs designed in ACCESS, the area of each ecosystem was calculated and quantified by Project component.




## Legend

- TEM & Plant Species At Risk Location
- Populated Place
- Highway
- Kluskus FSR
- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Exploration Road
- Existing Transmission Line
- Stream (>= 4th Order)
- Waterbody (>= 100 Ha)
- Proposed Mine Access Road
- Proposed Fresh Water Pipeline
- Proposed Transmission Line
- Proposed Transmission Line Reroute
- Proposed Airstrip Access Road
- Proposed Airstrip
- Proposed Mine Site

**Terrain, Soils, and Vegetation**

- Regional Study Area
- Local Study Area

**Biogeoclimatic Zone**

- BAFAun
- ESSFmv1
- ESSFmvp
- SBPSdc
- SBPSmc
- SBPSmk
- SBSdk
- SBSdw2
- SBSdw3
- SBSmc2
- SBSmc3
- SBSmk1

Scale: 1:450,000

0 5 10 20

Kilometres

**Reference**

BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

# Terrestrial Ecosystem Mapping and Plant Species at Risk Survey Locations

| | | |
|---|---|---|
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| GIS FILE: 06-100-062_PlotLocations_TEM_RP_4.mxd | | |
| PROJECTION: UTM Zone 10 | DATUM: NAD83 | amec |

Y:\GIS\Projects\VE\VE52095_Richfield_Blackwater\Mapping\06_vegetation\Baseline\06-100-062_PlotLocations_TEM_RP_4.mxd

#### *5.1.3.3.3.5 Ecosystems at Risk*

The BC CDC (2013) defines an ecosystem at risk as a community that is extirpated, endangered, threatened, or of special concern (i.e., Red- or Blue-listed). Similar to some plant species at risk, ecological communities have no legislated status. The BC CDC maps known locations of Red- and Blue-listed species and ecological communities. Detailed records are compiled for each known "Element Occurrence." The absence of recorded occurrences in the Project area does not necessarily mean there are no species or ecosystems at risk present, only that no species or ecosystems are currently recorded in the BC CDC database. A detailed assessment of the Project study area conducted during the appropriate season was used to confirm presence/absence of ecosystems at risk. For the purposes of this assessment, only upland ecosystems at risk were reported. As mentioned in **Section 5.1.3.3.1**, wetlands including wetland ecosystems at risk are presented in the Wetland Baseline Report.

#### *5.1.3.3.3.6 Sensitive Ecosystems*

##### *5.1.3.3.3.6.1 Riparian*

Riparian areas are corridors that occupy the area or shoreline adjacent to streams, lakes, and wetlands that develop a typically rich and diverse array of vegetation. In addition to contributing to biodiversity, riparian areas provide bank stability and connective corridors within a landscape and are an important source of coarse woody debris and nutrient input for aquatic ecosystems (Banner and MacKenzie, 1998). Riparian areas rely on adjacent upland habitat to support these important ecological functions. Because these functions are generally found within one tree height of a stream (Stevens et al., 1995), a buffer of 30 metres (m) assumed average tree height in LSA has been applied. For the purposes of depicting riparian areas on the ecosystem map, TEM and PEM polygons containing greater than 50% wetland ecosystems and Terrain Resource Information Management (TRIM) features (e.g., rivers, streams, lakes, marshes, and swamps) were buffered by 30 m,. Riparian areas also included the following riparian floodplain associations: Drummond's willow - Bluejoint, Black cottonwood - Dogwood - Prickly rose, low bench shrub floodplain, and low bench sedge herb floodplain.

##### *5.1.3.3.3.6.2 Old Growth Forests*

The age of old growth forests varies from one biogeoclimatic (BGC) unit to another. Forests that occur in areas where stand-initiating events are frequent have shorter intervals since their last disturbance, and old growth forests in these areas are generally older than 140 years. The time since last disturbance in stands with infrequent stand-initiating events is greater, and old growth forests in these areas are generally older than 250 years old. **Table 5.1.3.3-1** summarizes old growth forest classifications by BGC unit.

***Table 5.1.3.3-1: Relationship between BGC Unit and Old Growth Forest***

| Group | BGC Unit | Old Growth Forest |
|---|---|---|
| A | SBSdk, SBSdw3, SBSmc2, SBSmc3 | >140 years |
| B | ESSFmv1, ESSFmv1p | >250 years |

**Note**: BGC = Biogeoclimatic Unit; SBSdk = Sub-Boreal Spruce Dry Cold; SBSdw3 = Sub-Boreal Spruce Dry Warm Stuart variant; SBSmc2 = Sub-Boreal Spruce Moist Cold Babine variant; SBSmc3 = Sub-Boreal Spruce Moist Cold Kluskus variant; ESSFmv1 = Engelmann Spruce-Subalpine Fir Moist Very Cold variant; and ESSFmvp1 = Engelmann Spruce-Subalpine Fir Moist Very Cold Nechako Parkland variant.

The amount of old growth forest in each of the Project component LSAs was calculated based on the ecosystem map. In TEM, structural Stage 7 represents old forest; therefore, ecosystem units mapped as structural Stage 7 were selected to represent old growth forest. Structural stage was cross-referenced with VRI to validate the structural stage attribute.

The Kluskus FSR was based on PEM not TEM, and structural stage designation was not available in the PEM database for each ecosystem unit. The structural stage for the PEM portion was determined by intersecting each PEM polygon with a VRI polygon thus linking the required age class attribute. In VRI, age Class 8 represents 141–250 years, and age Class 9 represents 251+ years. Once age class was associated with each polygon, the age class was verified using the latest imagery available and converted to structural stage to provide a seamless map product for the Project area.

##### *5.1.3.3.3.6.3 Sparsely Vegetated*

Sparsely vegetated ecosystems are defined as areas where rock or talus limits vegetation establishment; vegetation cover is discontinuous and interspersed with bedrock or rock outcrops (Iverson et al., 2008). These include talus, cliff, and rock outcrops.

#### *5.1.3.3.3.7 Traditional Use Plants*

Traditionally, berries were considered crucial in trade and potlatch ceremonies. Berry picking and plant gathering still occur today. Interviews conducted with members from Saik'uz First Nation, Stellat'en First Nation, Ulkatcho First Nation, and Lhoosk'uz Dene Nation demonstrate reliance on plants for food. Representatives from the First Nation groups noted they consume soapberries, huckleberries, raspberries, strawberries, and blueberries, generally picked during the summer season. Areas where berry picking occur include the east side of Tatelkuz and some areas near the Stellaquo River.

Based on information from local First Nations regarding plant harvesting (**Section 14**) and on data available at the time of writing, berry-producing plants, including kinnickinnick (*Arctostaphylos uva-ursi*), were selected to represent traditional use plants. Traditional use plant habitat information was derived from baseline plot data that included plant species presence and abundance. Plant species that were berry-producing and occurred within the Project area were selected and correlated to site series. Using the ecosystem map potential, berry-producing areas were identified.

#### *5.1.3.3.3.8 Plant Species at Risk*

Plant species at risk are defined as vascular and non-vascular species that are Red- or Blue-listed by the BC CDC (BC CDC, 2013) or species listed as special concern, threatened, or endangered under Schedule 1 of the federal *SARA* (Government of Canada, 2002). The BC CDC database was queried to generate a list of potentially occurring plant species at risk in the Project area. This list included all plants from the BGC subzones that intersect with the Project area. The BC CDC defines Red- and Blue-listed species as follows:

- Red-listed: Any indigenous species or subspecies considered to be extirpated (species that no longer exist in the wild in BC), endangered (facing imminent extirpation or extinction), or threatened (likely to become endangered if limiting factors are not reversed) in BC; and
- Blue-listed: Any indigenous species or subspecies of special concern, formerly vulnerable. These species are particularity sensitive to human activities or natural events but not endangered or threatened.

The BC MOE's Endangered Species and Ecosystems—Non Sensitive Occurrences and Endangered Species and Ecosystems—Masked Sensitive Occurrences (DataBC, 2013a and 2013b) were reviewed in ArcMap to determine if any element occurrences (EOs) occur within the Project area, within 50 km of the Project area, or within BGC subzones contiguous to the Project area. An EO is defined by the BC CDC as follows:

- An area of land in which a species is or was present. The EO often corresponds with the local population, but when appropriate may be a portion of the population, or a group of populations.

A list of habitat preferences was compiled for each potential plant species at risk. These habitat requirements were summarized and used to target specific regions in the Project area during the plant species at risk field surveys. Particular attention was paid to micro-habitats, south exposures, rock outcrops, ecotones (transition zones), seepage areas (intermittent surface or subsurface water flow), and wet sites. Geology maps were reviewed to target areas of potential such as karst or limestone formations. Floristic data were recorded and survey sites were photographed. Plant identifications were made using *Flora of North America* (Flora of North America Editorial Committee, 2012) and *Illustrated Flora of BC* (Douglas et al., 1998–2002). Plants not identifiable in the field and putative plant species at risk were collected using recognized botanical plant pressing techniques and collection protocols (California Natural Resources Agency (CNRA), 2009) and later identified at the University of British Columbia (UBC) Herbarium.

#### *5.1.3.3.3.9 Invasive Plants*

AMEC defines an invasive plant as one that meets one or more of the following criteria:

- Is listed as an "alien invasive species" in Sections 1 or 2 of the BC Schedule of the Community Charter (2004);

- Is listed as a "noxious weed" in Part I or II of Schedule A of the BC *Weed Control Act* 1996 (Government of BC, 2011);
- Is listed as an "invasive plant" in the *Forest and Range Practices Act* (2004) as "extremely invasive," "very invasive," "invasive," or "aggressive or under bio-control" in Table 3 the NWIPC 2012 Strategic Plan and Plant Profiles (NWIPC, 2012);
- Is listed as a "priority species" in Appendix 1 of the Cariboo Chilcotin Coast Invasive Plant Committee 2012 Regional Strategic Plan; or
- Occurs within the jurisdictional boundaries of at least one of these acts, bylaws, or strategic plans.

The Invasive Alien Plant Program (IAPP) is administered by the BC MFLNRO (2013a) and records known locations of invasive species. The IAPP Application is an online database for invasive plant data in BC and shares information generated by various agencies and non-government organizations involved in invasive plant management. The IAPP database was queried to determine what invasive plants are known to occur within 20 km of the Regional Study Area (RSA).

#### 5.1.3.3.4 Results

Together the terrestrial LSA and RSA total approximately 45,000 hectares (ha). The LSA alone occupies 14,000 ha and the RSA around the LSA occupies 31,000 ha. The results are presented by LSA and then by RSA followed by a discussion on plant species at risk and invasive plants. The baseline conditions in the LSA and the RSA are described in terms of mapped units; the baseline conditions for plant species at risk and invasive plants are discussed with regard to individual plant locations.

##### *5.1.3.3.4.1 Baseline Condition in the LSA*

During the first two years (2011 and 2012), independent TEM and plant species at risk surveys were conducted, targeted to the proposed mine site. During the third year (2013), the TEM survey crew was accompanied by a plant species at risk specialist who searched for plant species at risk while the TEM crew completed its survey. In total, 492 plots were completed: 363 were within the combined LSAs; 71 were within the RSA; and 58 plots fell outside of the terrestrial RSA due to Project design changes. The target SILs mentioned in **Section 5.1.3.2** were achieved in all Project components. **Table 5.1.3.3-2** shows the number of plots by Project component and percent polygons inspected within the LSA. In the mine site LSA a total of 237 plots were completed at a ratio of 9 fulls: 183 grounds and 45 visuals.

***Table 5.1.3.3-2: Number of Plots and Percent Polygons Inspected by Project Component within the LSA***

| Project Component | Total No. of Plots | No. of Polygons >0.1 (ha) | Percent Polygons Inspected (%) | Project Component Area (ha) |
|---|---|---|---|---|
| Mine Site | 237 | 752 | 33 | 6,122 |
| Mine Site Access Road | 11 | 51 | 22 | 195 |
| Freshwater Supply System | 24 | 78 | 31 | 372 |
| Airstrip | 15 | 43 | 35 | 208 |
| Transmission Line | 51 | 1,004 | 5 | 4,290 |
| Mills Ranch Re-route | 11 | 93 | 12 | 505 |
| Stellako Re-route | 8 | 55 | 15 | 200 |
| Kluskus FSR | 6 | 637 | 1 | 2,426 |

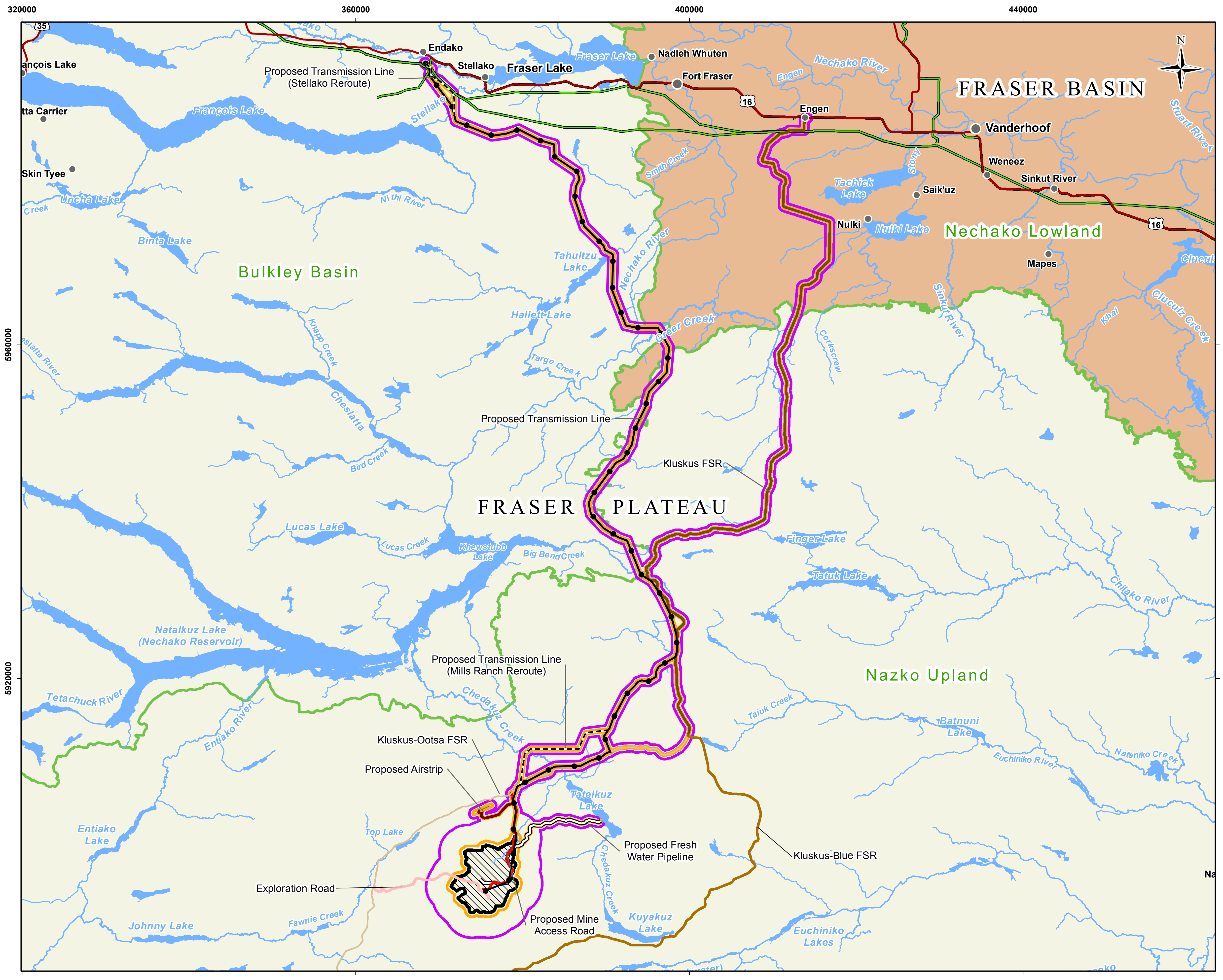
**Note:** No. = number, % = percent, ha = hectare; numbers are rounded for presentation purposes

The Project area spans two ecoregions: Fraser Plateau (FAP) and Fraser Basin (FAB). The FAP is represented by two ecosections—the Nazko Upland (NAU) and the Bulkley Basin (BUB)—and the FAB is represented by one ecosection—the Nechako Lowland (NEL). **Figure 5.1.3.3-3** shows the distribution of ecoregions and ecosections in the Project area.

There are six BGC units within the LSA:

- SBSdk (Dry Cool Sub-Boreal Spruce subzone);
- SBSdw3 (Stuart Dry Warm Sub-Boreal Spruce variant);
- SBSmc2 (Babine Moist Cold Sub-Boreal Spruce variant);
- SBSmc3 (Kluskus Moist Cold Sub-Boreal Spruce variant);
- ESSFmv1 (Nechako Moist Very Cold Engelmann Spruce-Subalpine Fir variant); and
- ESSFmv1p (Nechako Moist Very Cold Engelmann Spruce-Subalpine Fir Parkland variant).

The Project LSAs combined are approximately 14,300 ha, of which roughly 11,800 ha (83%) consist of upland ecosystems and 1,000 ha (7%) consist of non-vegetated, sparsely vegetated and anthropogenic areas. The largest BGC unit is the SBSmc3 with a total of 5,263 ha (37%). The second highest BGC unit is the ESSFmv1, which totals approximately 4,443 ha (31%), followed in decreasing order by the SBSdk, SBSdw3, SBSmc2, and ESSFmv1p. The baseline distribution of BGC units is shown in **Figure 5.1.3.3-4**.




**Legend**

- Populated Place
- Highway
- Kluskus FSR
- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Exploration Road
- Existing Transmission Line
- Stream (>= 4th Order)
- Waterbody (>= 100 Ha)
- Proposed Mine Access Road
- Proposed Fresh Water Pipeline
- Proposed Transmission Line
- Proposed Transmission Line Reroute
- Proposed Airstrip Access Road
- Proposed Airstrip
- Proposed Mine Site
- Fraser Basin Ecoregion
- Fraser Plateau Ecoregion
- Ecosection

**Terrain, Soils, and Vegetation**

- Regional Study Area
- Local Study Area

Scale: 1:450,000

0 5 10 20 Kilometres

**Reference**

BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Distribution of Ecoregions and Ecosections in the LSA

| | | |
|---|---|---|
| DATE: March, 2014 | ANALYST: AA | Figure 5.1.3.3-3 |
| JOB No: VE52420 | QA/QC: LR | PDF FILE: 06-100-065_Ecoregions_v3.pdf |
| GIS FILE: 06-100-065_Ecoregions_v3.mxd | | amec |
| PROJECTION: UTM Zone 10 | DATUM: NAD83 | |

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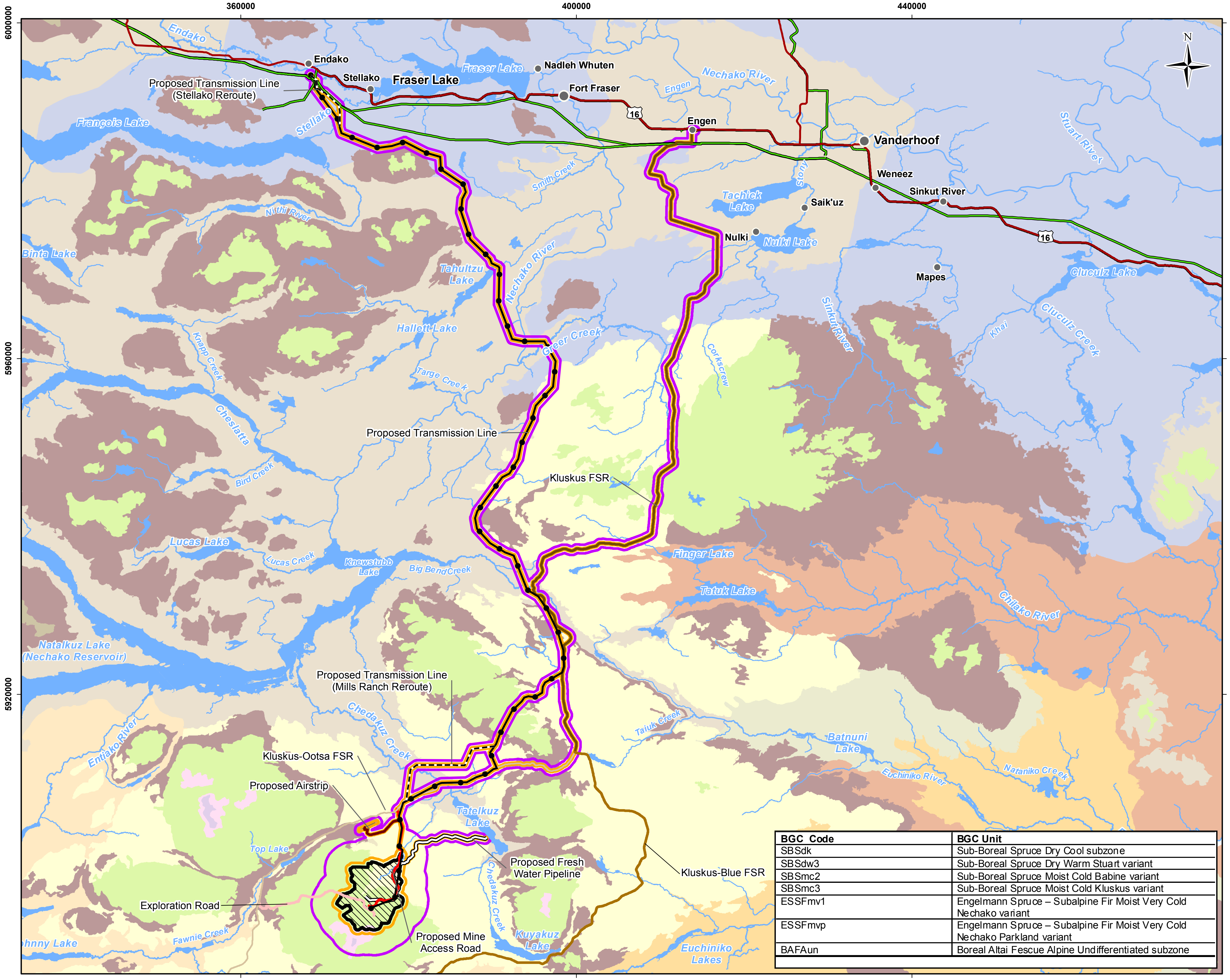


| BGC Code | BGC Unit |
|---|---|
| SBSdk | Sub-Boreal Spruce Dry Cool subzone |
| SBSdw3 | Sub-Boreal Spruce Dry Warm Stuart variant |
| SBSmc2 | Sub-Boreal Spruce Moist Cold Babine variant |
| SBSmc3 | Sub-Boreal Spruce Moist Cold Kluskus variant |
| ESSFmv1 | Engelmann Spruce – Subalpine Fir Moist Very Cold Nechako variant |
| ESSFmvp | Engelmann Spruce – Subalpine Fir Moist Very Cold Nechako Parkland variant |
| BAFAun | Boreal Altai Fescue Alpine Undifferentiated subzone |

**Legend**

- Populated Place
- Highway
- Kluskus FSR
- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Exploration Road
- Existing Transmission Line
- Stream (>= 4th Order)
- Waterbody (>= 100 Ha)
- Proposed Mine Access Road
- Proposed Fresh Water Pipeline
- Proposed Transmission Line
- Proposed Transmission Line Reroute
- Proposed Airstrip Access Road
- Proposed Airstrip
- Proposed Mine Site

**Terrain, Soils, and Vegetation**

- Regional Study Area
- Local Study Area

**Biogeoclimatic Zone**

- BAFAun
- ESSFmc
- ESSFmv1
- ESSFmvp
- SBPSdc
- SBPSmc
- SBPSmk
- SBSdk
- SBSdw2
- SBSdw3
- SBSmc2
- SBSmc3
- SBSmk1

Scale: 1:450,000

0 5 10 20

Kilometres

**Reference**

BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

# Distribution of Biogeoclimatic Subzones and Variants

| DATE: March, 2014 | ANALYST: AA | Figure 5.1.3.3-4 |
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###### *5.1.3.3.4.1.1 Ecosystem Distribution*

This section describes and quantifies the ecosystems (including upland and non-vegetated, sparsely vegetated and anthropogenic units) present within the Project LSA for the baseline case. Wetlands are addressed in the Wetland Baseline (**Appendix 5.3.7A**). There are six LSAs, each representing a Project component. The transmission line has two re-route options—Mills Ranch and Stellako.

In TEM mapping, ecosystem map units are either simple (containing one ecosystem unit) or complex, containing up to three ecosystem units. An ecosystem unit comprises site series (site modifiers, and structural stages. Detailed ecosystem descriptions and photographs for all plots are provided in Annex 3.1 of the Vegetation Baseline.

A map book is provided in Annex 3.2 of the Vegetation Baseline showing the distribution of ecosystems for the mine site, mine site access road, freshwater supply system, airstrip, transmission line, and Kluskus FSR.

Three BGC units listed from highest percent area to lowest represent the proposed mine site LSA: ESSFmv1, SBSmc3, and ESSFmv1p. The SBSmc3 and SBSdk occur within the proposed freshwater supply system LSA. The SBSmc3 and SBSmc2 occur within the proposed airstrip. The proposed transmission line LSA is a long (approximately 133 km) corridor and runs northwards from the mine site towards Endako. It is represented by the SBSdk, SBSmc3, SBSdw3, SBSmc2, and ESSFmv1 BGC units, listed from highest percent area to lowest. The existing Kluskus FSR LSA traverses the same BGC units as the transmission line; however, the SBSmc3 has the largest area followed by, in decreasing order: SBSdk, SBSdw3, ESSFmv1, and SBSmc2.

The topographic relief in the proposed mine site is moderately steep with an overall northerly aspect descending to Davidson Creek. Lower elevation areas near the proposed tailings storage facility, esker borrow pit, and freshwater reservoir have been extensively logged and evidence of mountain pine beetle infestation (standing dead grey trees) is severe. At higher elevations near the proposed open pit and waste rock pile, forestry activity (e.g., cutblocks and roads) is limited and mountain pine beetle infestation is less predominant mainly because the tree species composition varies.

The most abundant upland ecosystem within the proposed mine site LSA is the ESSFmv1 Subalpine fir - Rhododendron-Feathermoss (01/FR) ecosystem with a total of 1,829 ha (34%). Subalpine fir (*Abies lasiocarpa*) is by far the most abundant tree species in the canopy of this ecosystem. Engelmann spruce (*Picea engelmannii*) and lodgepole pine (*Pinus contorta* var. *latifolia*) are also present. White-flowered rhododendron (*Rhododendron albiflorum*) is a very common shrub in the understory, while five-leaved bramble (*Rubus pedatus*) and blueberries (*Vaccinium scoparium*, *V. caespitosum*) are common dwarf shrubs. The drier Subalpine fir - Huckleberry - Feathermoss (03/FF) is the second most common ecosystem in the mine site LSA with a total of 754 ha (14%). The SBSmc3 occupies a smaller area than the ESSFmv1. The Lodgepole pine - Feathermoss - Cladina (01/SB) covers a total of 615 ha (12%). Moist sites, such as those that support gooseberries (*Ribes species*) and twinberry (*Lonicera involucrata*), occur throughout the area but tend to be less extensive and restricted to lower slope moisture receiving areas.

Linear Project components occur mainly north of the mine site LSA and occupy lower elevations. The proposed freshwater supply system and mine site access road LSA are dominated by the mesic Hybrid white spruce - Huckleberry (SBSmc3 - 01/SB) ecosystem. The airstrip LSA is dominated by the dry Lodgepole pine - Feathermoss - Cladina (SBSmc3 03/LF) ecosystem and has a total of 41 ha (21%). Other common sites are the nutrient-poor black spruce (*Picea mariana*) forests (SBSmc3 - 05/BF) and the moist Hybrid white spruce - Twinberry (SBSmc3 - 07/ST) ecosystem.

The entire length of the transmission line traverses a variety of BGC units as well as various ecosystems. As a result, there is a greater diversity of ecosystems occurring within this LSA. The overall landscape includes a mixture of rural landscapes, forestry activity, roads, quarries, and cultivated fields. The most common ecosystem is the Hybrid white spruce - Purple peavine (SBSdk - 01/SP) with a total of 685 ha (17%). The Kluskus FSR is an existing road that intersects a variety of BGC units and as a result has a variety of ecosystems; the Hybrid white spruce - Huckleberry (SBSmc3 - 01/SB) is the most common with a total of 492 ha (22%).

##### *5.1.3.3.4.1.2 Ecosystems at Risk*

Based on the BC CDC (2013) database, 13 ecosystems at risk potentially occur in the Project area. Two of these—grassland communities (81/BW and 82/SW)—are the same ecosystem but occur in a different BGC variant. Four were confirmed by plot data; three plots in the Lodgepole pine - Common juniper - Rough-leaved ricegrass (SBSdk 02/LJ), one in the Drummond's willow - Bluejoint reedgrass (SBSdw3 Fl05), one in the Black cottonwood - Spruce - Red-osier dogwood (SBSdk 08/CD), and one in the Saskatoon - Slender wheatgrass (SBSdw3 81/SW).

Out of the 13 ecosystems at risk potentially occurring in the Project area, 10 were mapped in the LSA (**Table 5.1.3.3-3**). All ecosystems at risk occur along the proposed transmission line and existing Kluskus FSR. No terrestrial ecosystems at risk occur in the mine site LSA. For more details and maps showing the distribution of these ecosystems, refer to the Vegetation Baseline (**Appendix 5.1.3.3A**).

***Table 5.1.3.3-3: Ecosystems at Risk Potentially Occurring Within the Project Area***

| BGC | Ecosystem Group | Site Series | Map Code | Ecosystem | BC List | Plot Number | Mapped in LSA |
|---|---|---|---|---|---|---|---|
| SBSdk | Upland - Grassland | 82 | BW | Sandberg's bluegrass - Slender wheatgrass | Red | | ✗ |
| SBSdk | Upland - Grassland | 81 | SW | Saskatoon - Slender wheatgrass | Red | | ✓ |
| SBSdk | Upland - Forest | 02 | LJ | Lodgepole pine - Common juniper - Ricegrass | Blue | T-12-G226; T-12-G212; T-12-G026 | ✓ |
| SBSdk | Upland - Forest | 04 | DS | Douglas-fir - Soopolallie - Feathermoss | Blue | | ✓ |
| SBSdk | Upland - Flood | 08 | CD | Black cottonwood - Dogwood - Prickly Rose | Red | T-12-G208 | ✓ |
| SBSdk | Terrestrial - Flood | 00 | Fl02 | Mountain alder - Red-osier dogwood - Lady fern | Blue | | ✗ |
| SBSdk | Terrestrial - Flood | 00 | Fl05 | Drummond's willow - Bluejoint | Blue | | ✓ |
| SBSdw3 | Terrestrial - Grassland | 82 | BW | Sandberg's bluegrass - Slender wheatgrass | Red | | ✗ |
| SBSdw3 | Terrestrial - Grassland | 81 | SW | Saskatoon - Slender wheatgrass | Red | T-12-G214 | ✓ |
| SBSdw3 | Terrestrial - Forest | 02 | DC | Douglas-fir - Lodgepole pine - Cladonia | Blue | | ✓ |
| SBSdw3 | Terrestrial - Forest | 05 | BF | Lodgepole pine - Black spruce - Feathermoss | Blue | | ✓ |
| SBSdw3 | Terrestrial - Forest | 06 | SS | Hybrid white spruce - Pink spirea - Prickly rose | Blue | | ✓ |
| SBSdw3 | Terrestrial - Flood | 00 | Fl05 | Drummond's willow -Bluejoint | Blue | T13-020G | ✓ |

**Note:** BGC = Biogeoclimatic, SBSdk = Dry Cool Sub-Boreal Spruce, SBSdw3 = Dry Warm Stuart Sub-Boreal Spruce variant

### *5.1.3.3.4.1.3 Traditional Use Plants*

A total of 19 berry-producing species were chosen to represent traditional use plant and were confirmed to occur in the Project area by the baseline field program. All are upland species; wetlands are discussed in the Wetland Baseline. The 19 berry-producing shrubs including kinnickinnick (*Arctostaphylos uva ursi*) are listed in **Table 5.1.3.3-4**.

***Table 5.1.3.3-4: Berry-producing Plants that Occur in the Project Area.***

| Scientific Name | Common Name |
|---|---|
| *Amelanchier alnifolia* | Saskatoon |
| *Arctostaphylos uva-ursi* | kinnickinnick |
| *Fragaria virginiana* | wild strawberry |
| *Prunus pensylvanica* | pin cherry |
| *Ribes glandulosum* | skunk currant |
| *Ribes hudsonianum* | northern black currant |
| *Ribes lacustre* | black gooseberry |
| *Ribes sp.* | currant or gooseberry |
| *Ribes triste* | red swamp currant |
| *Rubus idaeus* | red raspberry |
| *Rubus parviflorus* | thimbleberry |
| *Rubus pedatus* | five-leaved bramble |
| *Rubus pubescens* | dwarf red-raspberry |
| *Shepherdia canadensis* | soopolalie |
| *Vaccinium caespitosum* | dwarf blueberry |
| *Vaccinium membranaceum* | black huckleberry |
| *Vaccinium myrtilloides* | velvet-leaved blueberry |
| *Vaccinium scoparium* | grouseberry |
| *Viburnum edule* | highbush cranberry |

In total, 247 plots correlating to 40 ecosystems identified berry-producing plants that occur at upland ecosystems. Total percent cover of berry-producing plants was calculated for each plot, and these values were used to calculate mean percent cover for each of the 40 ecosystems. Ecosystems with less than 4% berry cover were removed from the analysis as being too low to provide adequate berry-picking opportunities. A standard survey plot is 400 $m^2$; 4% is equivalent to 16 $m^2$. Ecosystems providing more than or equal to 4% berry-producing plants were carried forward into the analysis, resulting in 236 plots and 32 ecosystems.

The table below (**Table 5.1.3.3-5**) shows the list of 32 ecosystems that are likely to have sufficient berry-producing plants and berry-picking potential. The limitation of this analysis is that it does not take into account actual berry abundance but only that of berry-producing plants. Therefore, an ecosystem with a species such as black huckleberry (*Vaccinium membranaceum*) may be present yet the abundance of berries available at any given point in time is unknown. This type of analysis is beyond the scope and capability of this assessment as many variables contribute to a plant producing berries, such as exposure to sunlight or amount and timing of precipitation.

***Table 5.1.3.3-5: Ecosystems with Berry-Producing Potential***

| BGC Unit | Site Series | Map Code | Mean Percent Cover of Berry Producing Plants | Number of Plots |
|---|---|---|---|---|
| SBSdk | 01 | SP | 18 | 5 |
| SBSdk | 02 | LJ | 16 | 3 |
| SBSdk | 03 | LC | 50 | 1 |
| SBSdk | 05 | SF | 17 | 1 |
| SBSdk | 06 | ST | 16 | 6 |
| SBSdk | 08 | CD | 4 | 5 |
| SBSdw3 | 01 | SP | 11 | 2 |
| SBSdw3 | 03 | LC | 18 | 2 |
| SBSdw3 | 04 | SR | 25 | 9 |
| SBSdw3 | 07 | ST | 7 | 5 |
| SBSdw3 | 81 | SW | 55 | 1 |
| SBSmc2 | 01 | SB | 15 | 8 |
| SBSmc2 | 02 | PH | 19 | 1 |
| SBSmc2 | 04 | HB | 27 | 3 |
| SBSmc2 | 05 | TC | 20 | 1 |
| SBSmc2 | 09 | SD | 9 | 2 |
| SBSmc3 | 01 | SB | 19 | 26 |
| SBSmc3 | 02 | LJ | 11 | 6 |
| SBSmc3 | 03 | LF | 24 | 38 |
| SBSmc3 | 04 | SS | 4 | 3 |
| SBSmc3 | 05 | BH | 26 | 12 |
| SBSmc3 | 06 | BF | 12 | 7 |
| SBSmc3 | 07 | ST | 24 | 5 |
| ESSFmv1 | 00 | VG | 15 | 1 |
| ESSFmv1 | 01 | FR | 31 | 35 |
| ESSFmv1 | 02 | LC | 9 | 10 |
| ESSFmv1 | 03 | FF | 20 | 16 |
| ESSFmv1 | 04 | FG | 28 | 13 |
| ESSFmvp1 | 00 | PC | 21 | 5 |
| ESSFmvp1 | 00 | KC | 20 | 1 |
| ESSFmvp1 | 00 | FC | 15 | 1 |
| ESSFmvp1 | 00 | FH | 6 | 2 |

**Note:** BGC = biogeoclimatic, SBSdk = Dry Cool Sub-Boreal Spruce, SBSdw3 = Stuart Dry Warm Sub-Boreal Spruce variant, SBSmc2 = Babine Moist Cold Sub-Boreal Spruce variant; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant; ESSFmv1p = Nechako Very Cold Engelmann Spruce-Subalpine Fir Parkland variant.

Based on the analysis of the ecosystem map, a total of 10,962 ha of potential berry-producing ecosystems were determined to occur in the combined LSA (mine site and linear) for all Project components (**Table 5.1.3.3-6**). This corresponds to 24% of the combined LSA, which totals 45,000 ha. Of that, 5,042 ha (11%) of potential berry-producing plants occur in the mine site LSA.

***Table 5.1.3.3-6: Potential Berry-producing Ecosystems in the Project area LSA.***

| BGC Unit | Area of Potential Berry-producing Ecosystems (ha) |
|---|---|
| SBSdk | 1,831 |
| SBSdw3 | 809 |
| SBSmc2 | 409 |
| SBSmc3 | 4,017 |
| ESSFmv1 | 3,768 |
| ESSFmvp1 | 128 |
| **Total** | **10,962** |

**Note:** BGC = biogeoclimatic, SBSdk = Dry Cool Sub-Boreal Spruce, SBSdw3 = Stuart Dry Warm Sub-Boreal Spruce variant, SBSmc2 = Babine Moist Cold Sub-Boreal Spruce variant; SBSmc3 = Kluskus Moist Cold Sub-Boreal Spruce variant; ESSFmv1 = Nechako Very Cold Engelmann Spruce Subalpine Fir variant; ESSFmv1p = Nechako Very Cold Engelmann Spruce-Subalpine Fir Parkland variant.

### *5.1.3.3.4.2 Baseline Condition in the RSA*

#### *5.1.3.3.4.2.1 Ecosystem Distribution*

The RSA is one continuous boundary surrounding all the proposed features of the Project and totals approximately 45,000 ha. The baseline report describes the area that lies outside of the LSA, which totals approximately 31,000 ha, of which 25,500 ha (83%) are upland ecosystems and 1,700 (5%) are non-vegetated, sparsely vegetated, or anthropogenic. The same BGC units that occur in the LSA also occur in the RSA; however, the Undifferentiated Boreal Altai Fescue Alpine (BAFAun) subzone occurs in the southern portion of the RSA.

#### *5.1.3.3.4.2.2 Ecosystems at Risk*

The RSA surrounding the LSA covers approximately 31,000 ha of which 376 ha (1%) are ecosystems at risk. Of the 13 potentially occurring ecosystems at risk, 12 were mapped. Only the mountain alder - red-osier dogwood - lady fern (00/Fl02) ecosystem was not documented or mapped (**Table 5.1.3.3-3**). The distribution of upland ecosystems at risk in the RSA is shown on Figure 3.2-1 in **Appendix 5.1.3.3A**.

#### *5.1.3.3.4.2.3 Sensitive Ecosystems*

A small portion of the RSA has a high biodiversity emphasis rating with a total of 1,832 ha (6%). Most of the RSA occupies LUs that have been rated intermediate with a total of 20,956 ha (68%). The low biodiversity emphasis rated LUs have a combined total of 7,860 ha (26%).

The Entiako is the only LU that has a high biodiversity emphasis rating with a total of 1,832 ha (6%) occurring within the RSA; the area occurs southwest of the proposed mine site. Based on the BGC variant ESSFmv1 (Table 3.2-3, **Appendix 5.1.3.3A**), the percent old growth forest retention recommended by the 2004 Order is a minimum of 11% of the forested landscape (BC Integrated Land Management Bureau (ILMB), 2004)

Riparian area covers a total of 3,645 ha (12%), old growth forest covers a total of 4,857 ha (16%), and sparsely vegetated including cliff, talus, and rock outcrop covers less than 1%. Distribution of riparian, old growth forest, and sparsely vegetated areas in the RSA are shown on Figures 3.2-2 to 3.2-4 in **Appendix 5.1.3.3A**.

##### *5.1.3.3.4.3 Plant Species at Risk*

Plant species at risk were assessed based on the LSA and RSA combined. A total of 159 plant species at risk are potentially occurring within the Project area: one conifer, one deciduous shrubs, two ferns or fern allies, 65 forbs, 28 graminoids, and 62 mosses. A detailed list of potentially occurring plant species at risk, including scientific and common names and habitat criteria, is provided in Annex 4.1 of the Vegetation Baseline**, Appendix 5.1.3.3A.**

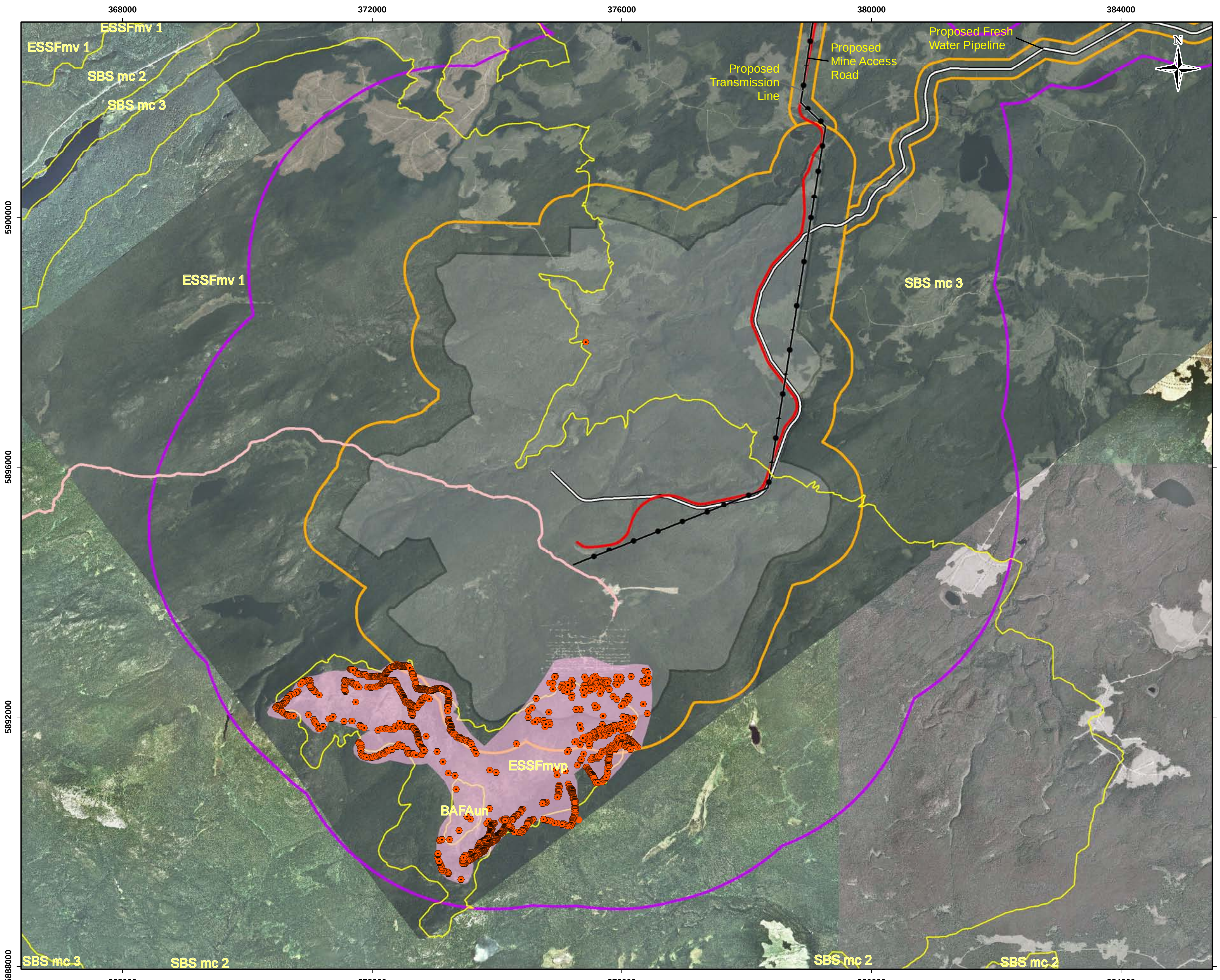
Five plant species at risk were documented within the Project area: whitebark pine (*Pinus albicaulis*), meesia moss (*Meesia longiseta*), sickleleaf tomentypnum moss (*Tomentypnum falcifolium*), small-flowered lousewort (*Pedicularis parviflora subsp. parviflora*), and swollen beaked sedge (*Carex rostrata*). Whitebark pine, sickleleaf tomentypnum moss, small-flowered lousewort, and meesia moss are found within the mine site LSA. Swollen beaked sedge and meesia moss occur within the mine site access road LSA. All other records, with the exception of the small-flowered lousewort, occur within the RSA as well. Four of the five plant species at risk are found in wetlands and detailed figures are provided in the Wetland Baseline (**Appendix 5.3.7A**). All five are Blue-listed by the BC CDC, but only whitebark pine is on Schedule 1 of the *SARA*.

The distribution of whitebark pine (*Pinus albicaulis*) was mapped by combining site data collected by AMEC with data collected by subcontractors (Alana Clason and Randy Moody). The whitebark pine habitat overlaps with the mine site. A total of 1,057 ha occur in the RSA of which 340 ha occur in the LSA. A rust survey was performed using standard white pine blister rust (*Cronartium ribicola*) survey methods (Tomback et al., 2001) in order to determine the level of rust in the whitebark pine population. Rust incidence (number of trees infected with active or inactive rust in the branch or stem) from 2012 (36%) combined with the three transects in 2013 (28%) provides an infection rate of 32% (total trees surveyed in 2012 in one area = 100; total trees surveyed in 2013 in three separate areas = 125). The Proponent has developed and will implement a whitebark pine management plan (Clason and Moody, 2013) in coordination with provincial regulators. Distribution of whitebark pine is shown in **Figure 5.1.3.3-5**.

##### *5.1.3.3.4.4 Invasive Plants*

The IAPP identified a total of 232 records and 24 invasive plant species that occur within 20 km of the RSA. One invasive plant species was observed within the mine site LSA, yellow salsify

(*Tragopogon dubius*), which is listed as an alien invasive species under Section 1 of the Schedule of the *Community Charter Act* (2004). Three locations and two invasive plant species occur within the transmission line LSA: Canada thistle (*Cirsium arvense (L.) Scop.*) and orange hawkweed (*Hieracium aurantiacum L.*). Along the Kluskus FSR, there are five locations and four invasive plant species: field scabrous (*Knautia arvensis (L.) Coult.*), common tansy (*Tanacetum vulgare L.*), yellow hawkweed (*Hieracium pratense = Hieracium caespitosum Dumort.*), and butter-and-eggs (*Linaria vulgaris P. Miller*). The distribution of invasive plants documented by IAPP are shown in **Figure 5.1.3.3-6**.




**Legend**

- Whitebark Pine
- Exploration Road
- Proposed Mine Access Road
- Proposed Fresh Water Pipeline
- Proposed Transmission Line
- White Bark Pine Distribution
- Biogeoclimatic Zone
- Proposed Mine Site

**Terrain, Soils, and Vegetation**

- Regional Study Area
- Local Study Area

Scale: 1:60,000

0 1 2

Kilometres

**Reference**

BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

# Distribution of Whitebark Pine (Pinus albicaulis)

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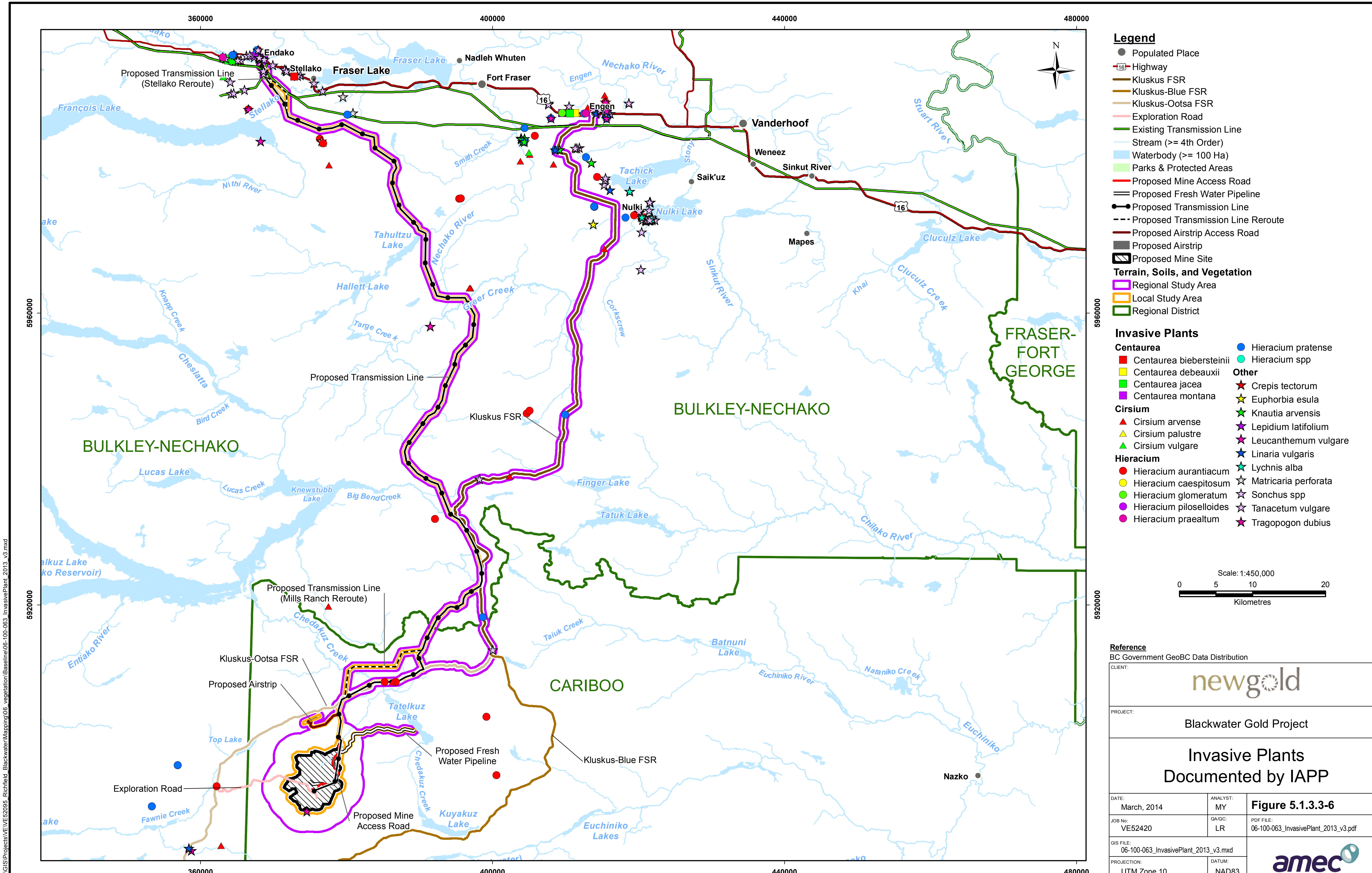
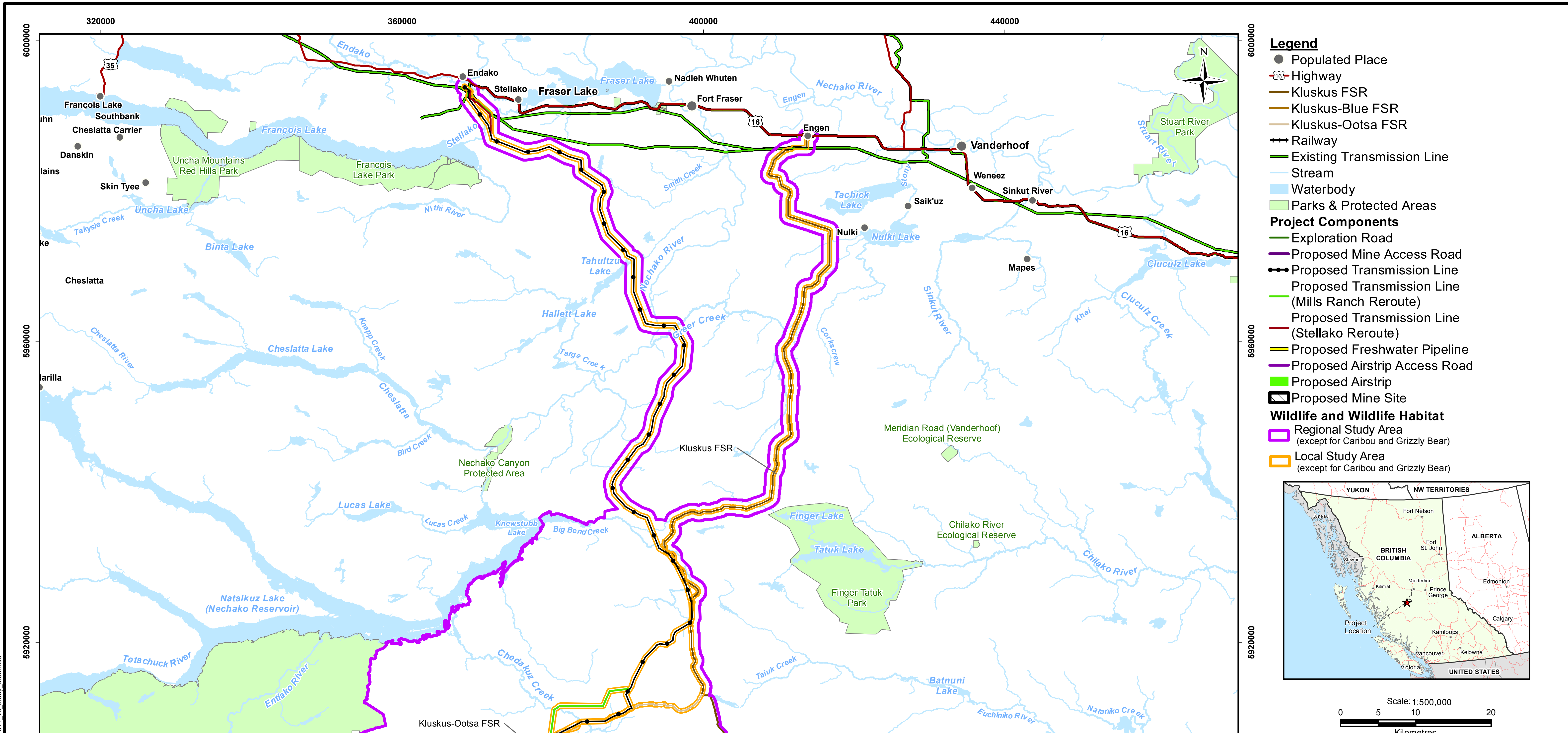

Legend
Populated Place
Highway
Kluskus FSR
Kluskus-Blue FSR
Kluskus-Ootsa FSR
Exploration Road
Existing Transmission Line
Stream (>= 4th Order)
Waterbody (>= 100 Ha)
Parks & Protected Areas
Proposed Mine Access Road
Proposed Fresh Water Pipeline
Proposed Transmission Line
Proposed Transmission Line Reroute
Proposed Airstrip Access Road
Proposed Airstrip
Proposed Mine Site
Terrain, Soils, and Vegetation
Regional Study Area
Local Study Area
Regional District
Invasive Plants
Centaurea
Centaurea biebersteinii
Centaurea debeauxii
Centaurea jacea
Centaurea montana
Cirsium
Cirsium arvense
Cirsium palustre
Cirsium vulgare
Hieracium
Hieracium aurantiacum
Hieracium caespitosum
Hieracium glomeratum
Hieracium piloselloides
Hieracium praealtum
Hieracium pratense
Hieracium spp
Other
Crepis tectorum
Euphorbia esula
Knautia arvensis
Lepidium latifolium
Leucanthemum vulgare
Linaria vulgaris
Lychnis alba
Matricaria perforata
Sonchus spp
Tanacetum vulgare
Tragopogon dubius
Scale: 1:450,000
0 5 10 20
Kilometres
Reference
BC Government GeoBC Data Distribution
CLIENT:
newgold
PROJECT:
Blackwater Gold Project
Invasive Plants
Documented by IAPP
DATE: March, 2014
ANALYST: MY
Figure 5.1.3.3-6
JOB No: VE52420
QA/QC: LR
PDF FILE: 06-100-063_InvasivePlant_2013_v3.pdf
GIS FILE: 06-100-063_InvasivePlant_2013_v3.mxd
PROJECTION: UTM Zone 10
DATUM: NAD83
amec
360000
400000
440000
480000
5960000
5920000
N
Endako
Stellako
Fraser Lake
Nadleh Whuten
Fort Fraser
Engen
Vanderhoof
Weneez
Sinkut River
Saik'uz
Nulki
Mapes
Nazko
Proposed Transmission Line
(Stellako Reroute)
Proposed Transmission Line
Kluskus FSR
Proposed Transmission Line
(Mills Ranch Reroute)
Kluskus-Ootsa FSR
Proposed Airstrip
Exploration Road
Proposed Mine
Access Road
Proposed Fresh
Water Pipeline
Kluskus-Blue FSR
BULKLEY-NECHAKO
BULKLEY-NECHAKO
FRASER-
FORT
GEORGE
CARIBOO
Fraser Lake
Nechako River
François Lake
Stellako
Tachick Lake
Nulki Lake
Cluculz Lake
Cluculz Creek
Stuart River
Nithi River
Smith Creek
Nechako River
Tahultzu Lake
Hallett Lake
Greer Creek
Targe Creek
Knapp Creek
Cheslatta
Bird Creek
Lucas Lake
Lucas Creek
Knewstubb Lake
Big Bend Creek
Finger Lake
Tatuk Lake
Chilako River
Sinkut River
Corkscrew
Khai
Taiuk Creek
Batnuni Lake
Euchiniko River
Nataniko Creek
Euchiniko
Chedakuz Creek
Tatelkuz Lake
Top Lake
Fawnie Creek
Kuyakuz Lake
Euchiniko Lakes
Entiako River
Y:\GIS\Projects\VE\VE52095_Richfield_Blackwater\Mapping\06_vegetation\Baseline\06-100-063_InvasivePlant_2013_v3.mxd

### 5.1.3.4 Wildlife and Wildlife Habitat

The topography of the wildlife and wildlife habitat RSA and LSA is generally rolling, with shallow valleys cut by major streams. The LSA and RSA are shown on **Figure 5.1.3.4-1**, **Figure 5.1.3.4-2**, and **Figure 5.1.3.4-3**. The higher elevations are north-aspect moderate to steep slopes within the RSA. There are occasional naturally non-forested grass/shrub habitats on south-aspect steep dry slopes below the Engelmann Spruce – Subalpine Fir (ESSF) biogeoclimatic (BGC) zone. There are numerous clearcuts in various stages of regeneration in the Sub-Boreal Spruce (SBS) and Sub-Boreal Pine – Spruce (SBPS) zones, with an associated network of forest service roads (FSRs). Non-forested wetlands are present but comprise a low proportion of the landscape.

The varied topography of the study areas accounts for the variety of BGC subzones and variants. At the highest elevations of Mount Davidson, the Boreal Altai Fescue Alpine undifferentiated subzone (BAFAun) is characterized by alpine tundra with scattered patches of stunted conifers, and alpine meadows with some short white spruce and pine (lodgepole and whitebark) species. Most of the exploration area is within the ESSF Nechako Moist Very Cold variant (ESSFmv1), which comprises mostly dense white spruce and some lodgepole pine and whitebark pine. The transmission line passes through the SBS Kluskus Moist Cold variant (SBSmc3), the SBS Stuart Dry Warm variant (SBSdw3), and the SBS Dry Cool subzone (SBSdk), all of which are dominated by lodgepole pine and white spruce forests. The southwest edge of the Project along the access road is within the SBS Blackwater Dry Warm variant (SBSdw2) and the SBPS Moist Cold subzone (SBPSmc), both of which are dominated by lodgepole pine and white spruce forests.




Reference
BC Government GeoBC Data Distribution

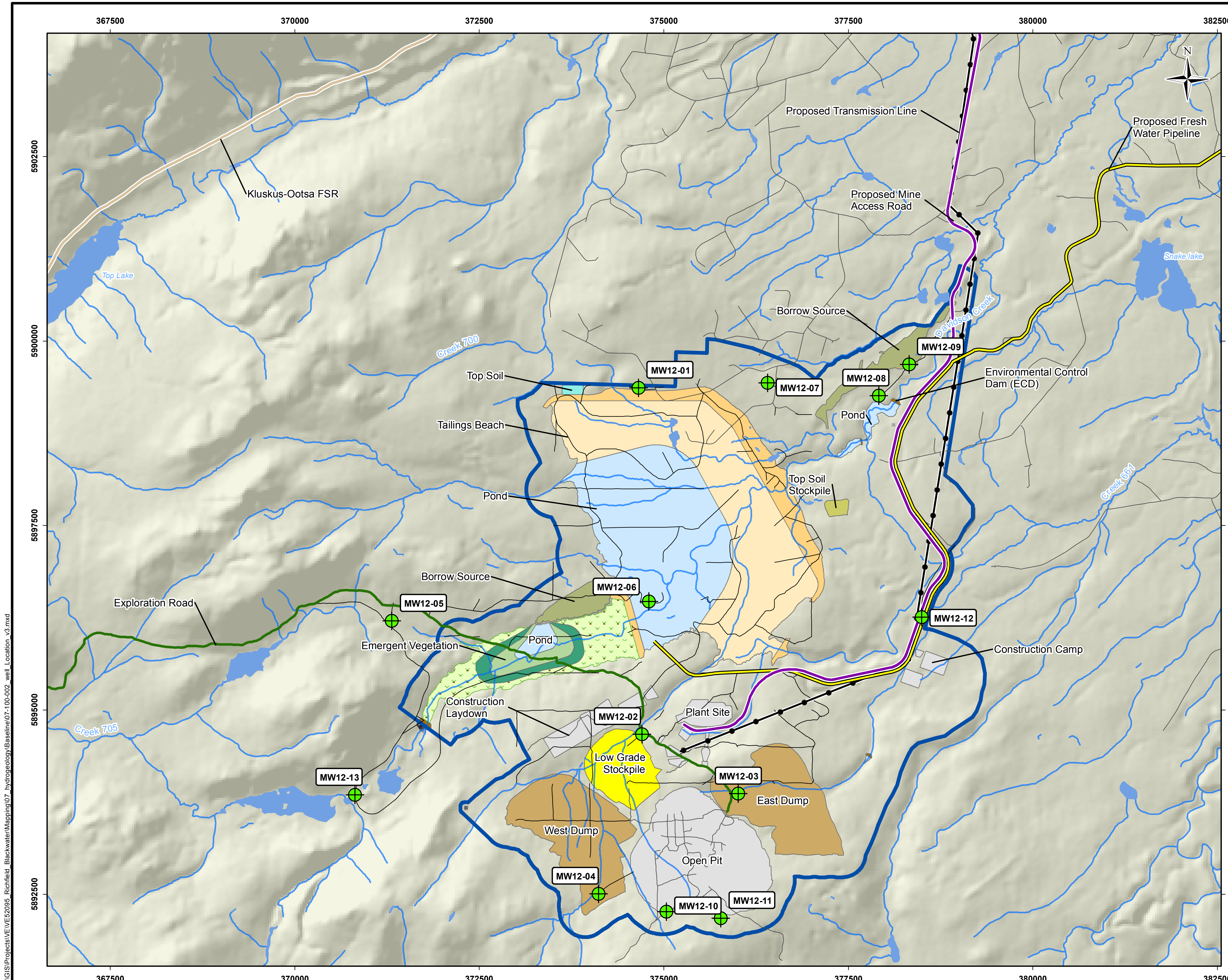
CLIENT: newgold

PROJECT: Blackwater Gold Project

# Wildlife and Wildlife Habitat Study Areas

| | | |
|---|---|---|
| DATE: May, 2014 | ANALYST: KA | Figure 5.1.3.4-1 |
| JOB No: VE52277 | QA/QC: LR | PDF FILE: 11-100-011_v8_study_area.pdf |
| GIS FILE: 11-100-011_v8_study_area.mxd | | |
| PROJECTION: UTM Zone 10 | DATUM: NAD83 | amec |

Y:\GIS\Projects\VE\VE52095_Richfield_Blackwater\Mapping\11_wildlife\Baseline\11-100-011_v8_study_area.mxd




**Legend**

- Sampling Well Locations
- Existing Road
- Contour (20 m)
- Stream
- Waterbody
- Kluskus-Ootsa FSR
- Exploration Road
- Proposed Mine Access Road
- Proposed Transmission Line
- Proposed Fresh Water Pipeline
- Proposed Mine Site
- Bog / Wetland Area
- Dam
- Dump
- Embankment Fill
- Emergent Vegetation Wetland
- Environmental Control Dam (ECD)
- Borrow Source
- Fresh water Reservoir
- Low-Grade Stockpile
- Open Pit
- Plant Site
- Pond
- Tailings Beach
- Top Soil
- Topsoil Stockpile
- Upland Beach

Scale:1:50,000

0 0.5 1 2

Kilometres

**Reference**

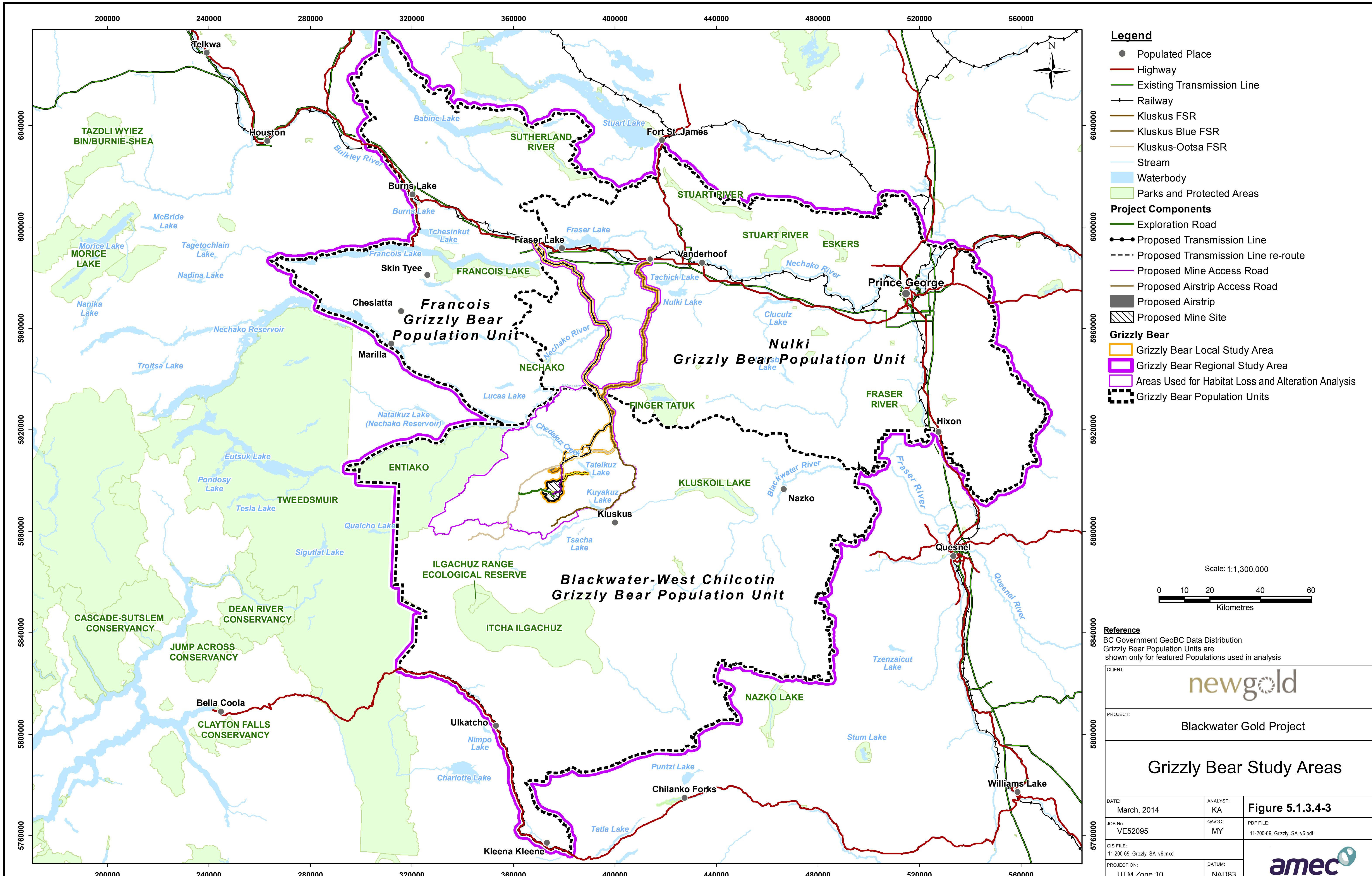
BC Government GeoBC Data Distribution

CLIENT: newgold

PROJECT: Blackwater Gold Project

Caribou Study Areas

| | | |
|---|---|---|
| DATE: March, 2014 | ANALYST: AA | **Figure 5.1.3.4-2** |
| JOB No: VE52277 | QA/QC: WR | PDF FILE: 07-100-002_well_Location_v3_minsite.pdf |
| GIS FILE: 07-100-002_well_Location_v3.mxd | | |
| PROJECTION: UTM Zone 10 | DATUM: NAD83 | amec |



Legend
Populated Place
Highway
Existing Transmission Line
Railway
Kluskus FSR
Kluskus Blue FSR
Kluskus-Ootsa FSR
Stream
Waterbody
Parks and Protected Areas
Project Components
Exploration Road
Proposed Transmission Line
Proposed Transmission Line re-route
Proposed Mine Access Road
Proposed Airstrip Access Road
Proposed Airstrip
Proposed Mine Site
Grizzly Bear
Grizzly Bear Local Study Area
Grizzly Bear Regional Study Area
Areas Used for Habitat Loss and Alteration Analysis
Grizzly Bear Population Units
Francois Grizzly Bear Population Unit
Nulki Grizzly Bear Population Unit
Blackwater-West Chilcotin Grizzly Bear Population Unit
Telkwa
Houston
Burns Lake
Fraser Lake
Fort St. James
Vanderhoof
Prince George
Skin Tyee
Cheslatta
Marilla
Hixon
Nazko
Kluskus
Quesnel
Ulkatcho
Bella Coola
Chilanko Forks
Williams Lake
Kleena Kleene
TAZDLI WYIEZ BIN/BURNIE-SHEA
MORICE LAKE
SUTHERLAND RIVER
STUART RIVER
ESKERS
FRANCOIS LAKE
NECHAKO
FINGER TATUK
FRASER RIVER
ENTIAKO
KLUSKOIL LAKE
TWEEDSMUIR
ILGACHUZ RANGE ECOLOGICAL RESERVE
ITCHA ILGACHUZ
CASCADE-SUTSLEM CONSERVANCY
DEAN RIVER CONSERVANCY
JUMP ACROSS CONSERVANCY
CLAYTON FALLS CONSERVANCY
NAZKO LAKE
Babine Lake
Stuart Lake
Bulkley River
Burns Lake
Fraser Lake
Tchesinkut Lake
Francois Lake
McBride Lake
Morice Lake
Tagetochlain Lake
Nadina Lake
Nanika Lake
Nechako Reservoir
Troitsa Lake
Tachick Lake
Nulki Lake
Nechako River
Cluculz Lake
Lucas Lake
Natalkuz Lake (Nechako Reservoir)
Chedakuz Creek
Tatelkuz Lake
Kuyakuz Lake
Tsacha Lake
Blackwater River
Fraser River
Quesnel River
Eutsuk Lake
Pondosy Lake
Tesla Lake
Qualcho Lake
Sigutlat Lake
Tzenzaicut Lake
Stum Lake
Puntzi Lake
Nimpo Lake
Charlotte Lake
Tatla Lake
Scale: 1:1,300,000
0 10 20 40 60
Kilometres
Reference
BC Government GeoBC Data Distribution
Grizzly Bear Population Units are shown only for featured Populations used in analysis
CLIENT:
newgold
PROJECT:
Blackwater Gold Project
Grizzly Bear Study Areas
DATE: March, 2014
ANALYST: KA
Figure 5.1.3.4-3
JOB No: VE52095
QA/QC: MY
PDF FILE: 11-200-69_Grizzly_SA_v6.pdf
GIS FILE: 11-200-69_Grizzly_SA_v6.mxd
PROJECTION: UTM Zone 10
DATUM: NAD83
amec

#### 5.1.3.4.1 Introduction

This section presents the results of the wildlife literature and regulatory review and wildlife field studies conducted from 2011 to 2013. Surveys were conducted on species groups that represented nine VCs selected for the effects assessment. The VCs and their indicators/factors for assessment were selected because of the potential for effects, either locally or cumulatively, and their importance based on concerns of First Nations, other resource users, and regulators.

The VCs and indicators selected and surveyed from 2011 to 2013 include:

- Amphibians – western toad and habitat;
- Water birds – ring-necked duck and habitat, yellow rail and habitat;
- Forest and grassland birds – olive-sided flycatcher and habitat, red-tailed hawk and habitat, Clark's nutcracker and habitat;
- Moose – moose and habitat;
- Caribou – caribou and habitat;
- Grizzly bear – grizzly bear and habitat;
- Furbearers – marten and beaver and martin and beaver habitat;
- Bats – little brown myotis and habitat; and
- Invertebrates – Jutta Arctic and habitat, American emerald and habitat.

Baseline surveys were conducted to identify amphibians, reptiles, birds, mammals, and invertebrates that were present within the LSA and RSA (**Appendix 5.1.3.4A,** Section 2.1).

Wildlife RISC survey methodologies used are shown in **Table 5.1.3.4-1** and discussed in **Appendix 5.1.3.4A**. Summary of survey effort completed for each of the LSAs / RSAs in 2011 and 2012 for the Project is presented in **Table 5.1.3.4-2**.

### *Table 5.1.3.4-1: Wildlife RISC Survey Methodology*

| ***Species*** | ***Survey Methodology*** | ***Survey Level*** |
|---|---|---|
| Amphibian (western toad);and reptile surveys | Time Constrained Surveys, Roadside Surveys | Inventory methods used in 2011 and 2012 followed the protocols for verification of the presence or non-detection of species, as described in the Inventory Methods for Pond Breeding Amphibians and Painted Turtle (Resource Inventory Standards Committee (RISC) 1998b). |
| Birds (forest and grassland songbirds, common nighthawk, sharp-tailed grouse, Clark's nutcrackers, raptors, and water birds) | Variable Radius Point Counts (breeding birds), Aerial Waterbird Survey (waterbirds), Call Playback (raptors) Surveys, Roadside surveys (raptors), Stand watches (raptors), recordings (yellow rail, bittern) | Variable point count (PC) protocol described in the Inventory Methods for Forest and Grassland Songbirds (RISC 1999a), which enables identification of a wide range of bird species along transects (Ralph et al., 1995). Common nighthawk surveys at dusk to determine presence / non-detected also used PC stations and followed the methodology specified in the RISC standards for Inventorying Nighthawks and Poorwills (RISC 1998c). Transect surveys followed the methodology in the draft protocol for monitoring Clark's Nutcracker populations as described by Tomback (2005).<br><br>Due to differences in their behaviour, separate surveys were conducted during the day and night for diurnal and nocturnal raptors, respectively as indicated in the RISC Inventory Methods for Raptors (RISC 2001). During the breeding season birds use calls and songs to establish and defend territories, attract mates, and communicate with young. Raptors, however, are generally silent even during the breeding season, which decreases their detectability using passive monitoring methods. Playing raptor calls is frequently used as a means to detect raptors during the breeding season (RISC 2001).<br><br>Stand watch surveys were used for both nocturnal and diurnal raptors, but specifically at dusk and dawn to survey for short-eared owls, whereas diurnal surveys were used to monitor all diurnal species during daylight hours.<br>Aerial waterbird surveys were conducted using modified aerial transect survey methodology (RISC 1999). Wetlands and other waterbodies were identified prior to surveys, and transects flown in the study area |
| Mammals (furbearer, caribou, bear) | Acoustic Bat Surveys (bats), Aerial Winter Tracking Surveys (ungulates, furbearers), Ground Winter Tracking Survey (ungulates, furbearers) | Aerial winter track surveys were conducted in 2011 to determine the spatial distribution of the local ungulates, and furbearer populations within the study area following a modified RISC encounter transect method as indicated in the Inventory Methods for Medium-Sized Territorial Carnivores – Coyote, Red Fox, Lynx, Bobcat, Fisher, and Badger (RISC1999b).<br><br>Wildlife track count surveys were established on the ground in 2012 to determine the presence and distribution of terrestrial furbearer and ungulate species, including the winter presence and distribution of northern caribou. |
| Invertebrates (butterfly, dragonfly, damselfly) | Ground based transects / plots | Inventories for Odonata (dragonflies and damselflies) and Lepidoptera (butterflies and skippers) generally followed RISC protocols as indicated in the methodology in the Inventory for Terrestrial Arthropods (1998d). |
| Bats | Acoustic surveys | Bat surveys used an Anabat II detector to record bat calls, which were sent to a regional bat biologist for identification. Inventory methods adhered to modified RISC standards (RISC 1998). An Anabat II detector was placed at various locations within the study area, with a focus on the mine site LSA during both 2011 and 2012. |

| ***Species*** | ***Survey Methodology*** | ***Survey Level*** |
|---|---|---|
| Kokanee salmon spawning streams for black and grizzly bears | Remote Camera Survey | In order to monitor bear activity along kokanee spawning streams, motion activated cameras were set up and sign survey transects conducted along Davidson Creek, Creek 661, and Chedakuz Creek in 2012 |
| Bear denning study for black and grizzly bears | Ground search Bear Den Survey | Dexter Hodder with the University of Northern BC (UNBC) created a model for predicting the location of bear dens within the proposed Project area. A desktop overview was used to develop ratings and create a model to identify areas that needed to be visited in the field. An initial aerial survey helped to identify potential denning habitat which the model had failed to note and could later be searched during ground transects. |
| Caribou forage lichen survey | Ground based transects / plots | The forage lichen survey was separated into two survey components; arboreal and terrestrial lichens. Existing spatial data were used to map high and moderate potential areas of terrestrial lichen using Vegetation Resource Inventory (VRI) and Predictive Ecosystem Mapping (PEM) data. Areas identified as high potential were the same in each of the datasets; however, the data sets for moderate potential differed between VRI and PEM and all of the areas rated as moderate were selected. Transect surveys were established to survey arboreal lichen following the methodology in Stevenson et al., (1998). |
| Sharp-tailed grouse lek sites | n/a | Inventory studies of sharp-tailed grouse were designed to identify the location of individual leks where individual grouse could be counted. Studies followed the RISC Standardized Methodologies for Components of British Columbias Biodiversity: Upland Game Birds Grouse, Quail, and Columbids (RISC 1997). |
| Whitebark pine ecosystem for Clark's nutcrackers | n/a | n/a |

***Table 5.1.3.4-2: Summary of Survey Effort Completed for Each of the LSAs / RSAs in 2011 and 2012 for the Proposed Project***

| Survey Group | Target Group | Survey Type | Mine Site | | Transmission Line | | Access Route | | Pipeline | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2011 | 2012 | 2011 | 2012 | 2011 | 2012 | 2011 | 2012 |
| Amphibians | Amphibians | Time Constrained Surveys | ● | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | Amphibians | Roadside Surveys | ○ | ● | ○ | □ | ○ | □ | ○ | ● |
| Birds | Songbirds | Point Counts | ● | ● | ○ | □ | ○ | □ | ○ | ○ |
| | Waterbirds | Aerial Waterbird Survey | ● | ● | ○ | ○ | ○ | ○ | ○ | ○ |
| | Sharp-tailed Grouse | Point Counts | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ |
| | Raptors | Call Playback Survey | □ | ● | ○ | □ | ○ | □ | ○ | □ |
| | | Roadside Surveys | □ | ● | ○ | □ | ○ | □ | ○ | □ |
| | | Standwatch | □ | ● | ○ | □ | ○ | ○ | ○ | ○ |
| Mammals | Bats | Acoustic Bat Survey | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ |
| | Ungulates / Furbearers | Aerial Winter Tracking Survey | ● | ○ | ○ | ○ | □ | ○ | ○ | ○ |
| | Ungulates / Furbearers | Ground Winter Tracking Survey | ○ | ● | ○ | ○ | ○ | ○ | ○ | ● |
| | Bears | Bear Den Survey | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ |
| | | Remote Camera Survey | ○ | ● | ○ | ○ | ○ | ○ | ○ | ○ |
| Invertebrates | Butterflies | Transect | ● | ● | ○ | □ | ○ | □ | ○ | □ |
| | Dragonflies | Transect | ● | ● | ○ | □ | ○ | □ | ○ | □ |

**Note:** ● = intensive coverage; □= partial coverage; ○ = no coverage

The LSA includes the proposed mine site area (the mine site footprint plus a 500 m buffer), and all linear components areas (linear components with 250 m buffer on each side of linear component boundary, except for the airstrip which is 300 m buffer on each side). The linear component boundary, also referred to as the footprint, is comprised of the feature's right-of-way (ROW) and an additional buffer. The linear component boundary widths are as follows: existing Kluskus FSR is 20 m (20 m ROW with no buffer), proposed mine access road is 120 m (20 m ROW with 50 m buffer each side), proposed transmission line is 140 m (40 m ROW with 50 m buffer on each side), proposed freshwater supply pipeline is 110 m (10 m ROW with 50 m buffer on each side), proposed airstrip is 200 m (100 m ROW with 50 m buffer each side), and the proposed airstrip access road is 10 m (10 m ROW, with no buffer). The FSR re-alignment and Transmission Line access roads are included in the LSA area for these features. The transmission line includes a mainline route and two potential re-routes, the Mills Ranch and Stellako options.

The RSA is large enough to assess the seasonal home range movements and important seasonal habitats of most species considered, some of which have long distance movement patterns. The RSA was selected to include a wide variety of habitat types also found in the LSA, allowing the assessment of relative abundance of habitat within the LSA relative to the greater region where the Project is situated.

This section identifies wildlife study objectives, methods, and results of the baseline wildlife surveys.

Tasks included:

- Completion of background literature and information reviews for wildlife species associated with the study areas and potential habitat;
- Site reconnaissance visits to develop the wildlife study areas;
- Investigation and confirmation of the presence of environmentally sensitive wildlife species or areas identified during background searches;
- Completion of wildlife field habitat mapping as part of the vegetation TEM program (changes in wildlife productivity will be inferred based on TEM and suitability modelling);
- Collection of baseline data for wildlife groups, photo-documentation, and other pertinent information;
- Species groups and species-specific surveys for amphibians, birds, mammals, and invertebrates including:
    - Amphibian (western toad) and reptile surveys;
    - Birds (forest and grassland birds, common nighthawk, sharp-tailed grouse, Clark’s nutcracker, raptors, and water birds (including yellow rail surveys));
    - Mammals (furbearers, caribou, bear);
    - Invertebrates (butterfly, dragonfly, damselfly);
- Surveys of important wildlife habitats including:
    - Wetlands for water birds and waterfowl surveys (brood and fall migration);
    - Kokanee salmon spawning streams for black bear and grizzly bear;
    - Bear denning study for black bear and grizzly bear;
    - Caribou forage lichen survey;
    - Winter tracking of ungulates and furbearers;
    - Sharp-tailed grouse lake sites;
    - Common nighthawk; and
    - Whitebark pine ecosystem for Clark’s nutcracker.

Methodology followed RISC standards where they had been established for a particular species group or survey type. Several surveys without RISC standards followed established methodologies as determined by a primary literature review. Surveys on birds also followed the

Canadian Wildlife Services (CWS) technical report framework for the scientific assessment of potential project impacts on birds (Hanson et al., 2009).

Twenty-eight (28) wildlife species at risk (i.e., federal and provincial species of conservation concern) were identified as having the potential to occur in the Project area for either breeding and/or foraging.

These include eight potential species listed under the federal *Species at Risk Act* (*SARA*) Schedule 1 List of Wildlife Species at Risk (one amphibian species, six bird species, and one mammal species) (Government of Canada, 2002). Field surveys and incidental sightings resulted in five species listed under the federal Schedule 1 occurring within the mine site LSA and six species occurring within the LSA of the linear features and RSA.

A total of 24 provincially-listed wildlife species (five Red- and 19 Blue-listed) (BC CDC, 2014) potentially occur within the Project area. Of these species, 22 potentially occur within the mine site LSA; during fieldwork, two Red- and nine Blue-listed species were detected within the mine site LSA. Within the access route LSA, 21 listed species (three Red- and 18 Blue-listed) potentially occur; baseline surveys detected one Blue-listed species. Twenty-three listed species (four Red- and 19 Blue-listed) potentially occur within the transmission line LSA; baseline surveys detected one Red- and five Blue-listed species. Within the freshwater supply pipeline LSA, 19 listed species (three Red- and 16 Blue-listed) potentially occur; one Red- and two Blue-listed species were detected. Within the airstrip LSA, 15 listed species (two Red- and 12 Blue-listed) potentially occur; baseline surveys detected two Red- and two Blue-listed species. Twenty-four listed species (four Red- and 20 Blue-listed) potentially occur within the RSA; subsequent surveys detected 12 Blue-listed species. The details of the locations and habitat of these species, as well as the survey effort for each of the LSAs and RSA, are discussed in the respective species group summaries.

In addition to species at risk identified federally, provincially, and regionally, species of management concern were included in the baseline assessment that had been identified by local naturalists and interest groups and Aboriginal Groups and First Nations (**Section 5.4.1**).

Five categories of assessment were addressed to examine the following potential Project effects on wildlife and wildlife habitats:

- Change in habitat availability (habitat loss and alteration);
- Change in wildlife population dynamics;
- Change in wildlife mortality risk associated with physical hazards and attractants (physical hazards);
- Change in wildlife movement patterns (including assessment of possible sensory disturbance causing wildlife attraction or deterrence); and
- Change in wildlife health (including assessment of possible chemical hazards and attractants for wildlife).

A range of potential effects on invertebrates can be associated with a mine site, linear features including roads, water pipelines and an electrical transmission line. Activities occurring during each phase of the Project could potentially interact with invertebrates. Habitat loss, features that act as attractants, potential mortality, changes in habitat availability, noise disturbance (displacement), changes in predator numbers, and disruptions of movement are the predicted key and moderate interactions of the proposed Project related to invertebrates. Taking a conservative approach, both Key and Moderate interactions are combined and considered jointly in assessment of project (**Section 5.4**).

Rare and listed wildlife species and their habitats covered by *SARA*, COSEWIC, and BC provincial Red and Blue lists (BC CDC, 2012) are addressed within the individual indicator species groups and communities within the wildlife VCs assessment. For instance, western toad are the key indicator species assessed for amphibians; caribou are addressed within the mammals group of wildlife indicators; bird species at risk are included in the bird community indicator groups for forest / grassland birds, aquatic birds and early seral and old growth bird communities. Detailed species lists of species at risk that may be affected by project activities are summarized in the baseline studies and effects are identified for indicator species and communities that represent the range of species at risk and their environments. Activities occurring during each phase of the proposed Project could potentially interact with rare and listed wildlife species. Habitat loss, features that act as attractants, potential mortality, changes in habitat availability, noise disturbance (displacement), changes in predator numbers, predation rates, and disruptions of movement are the predicted key and moderate interactions of the proposed Project related to rare and listed wildlife species and their habitats. Taking a conservative approach, both Key and Moderate interactions are combined and considered jointly in assessment of project for indicator species representing these wildlife species.

Species of cultural and economic importance to humans are identified within the VC and key indicator species sections and include mammals such as caribou, moose, deer, bear and furbearers such as beaver, marten, fisher, wolverine and wolves. Species such as grouse, raptors and waterfowl are addressed through the assessment of bird VCs and indicator species. Activities occurring during each phase of the proposed Project could potentially interact with wildlife species that are of importance to the local economy, local communities, First Nations. Habitat loss, features that act as attractants, potential mortality, change in habitat availability, noise disturbance (displacement), changes in predator numbers, predation rates, and disruptions of movement are the predicted key and moderate interactions of the proposed Project related to wildlife of cultural and economic importance and their habitats. Taking a conservative approach, both Key and Moderate interactions are combined and considered jointly in assessment of project for indicator species representing these wildlife species.

#### 5.1.3.4.2 Habitat

Baseline studies were used to supplement desktop research on wildlife species VCs and indicator species life histories and strategies to document important habitat and expected zones of influence. Field wildlife habitat assessments were conducted for focal species and used to validate habitat suitability ratings developed for the VC and indicator species. These data were used to model suitable habitat for species and to analyze potential habitat effects from the Project.

Baseline surveys documented the occurrence of wildlife species and habitat in the Project area. Wildlife presence was analyzed and habitat associations were rated using TEM and Predictive Ecosystem Mapping (PEM). Potential habitat within the Project area was rated for each indicator species using RISC standards (RISC, 1999); wildlife habitat assessment data along with habitat associations determined through baseline survey analysis were subsequently used to validate the suitability ratings. These ratings were then used to calculate the area of moderate to high value habitats in the Project area and identify the potential for Project activities to cause loss in quantity or quality of habitats. Mitigative measures, including the Reclamation and Closure Plan (**Section 2.6**), were identified to reduce Project effects on wildlife VCs.

Known and potential critical habitats were identified through baseline surveys as well as literature reviews, open houses, and correspondence with regulators. The existing environment and habitat also included consideration of existing or proposed protected areas, special management areas, and conservation areas in the RSA, which are described in **Section 2.7**.

#### 5.1.3.4.3 Amphibians and Reptiles

All four amphibian species expected to occur within the region were detected within the Project area, including the mine site LSA, the Kluskus FSR LSA, and the RSA. The four amphibian species include the western toad (*Anaxyrus boreas*), Columbia spotted frog (*Rana luteiventris*), wood frog (*Lithobates sylvatica*), and long-toed salamander (*Ambystoma anabystoma*). Breeding for these species was confirmed in the mine site LSA and RSA; the Blue-listed and *SARA*-listed western toad was detected breeding in all study areas except the mine access road LSA and airstrip LSA. The largest number of breeding sites for western toad was detected within the RSA followed by the transmission line LSA. Waterbodies that provide suitable habitat are likely used by the western toad given that the species is found in a wide variety of habitats, including forests, grasslands, and subalpine meadows. The only reptile detected was a common garter snake (*Thamnophis sirtalis*), which was found dead on the Kluskus FSR.

The wildlife habitat suitability ratings identified moderate and high value habitats of the western toad within the Project area. The Project footprint was overlaid on the identified habitats to determine the quantity and quality of habitats that will be affected and to develop mitigation measures to reduce effects (**Section 12.2.1.18.4.6**). Potential effects to amphibians include habitat loss and alteration, changes in population dynamics, mortality risk, changes in movement patterns, and health (**Section 5.4.7, Table 5.4.7-5**)."

#### 5.1.3.4.4 Forest and Grassland Birds

Forest and grassland birds are important to local residents and Aboriginal groups. Aboriginal members residing at Tatelkus Lake Indian Reserve #28 (IR#28) have indicated they harvest grouse as a food source. Aboriginal groups have raised concerns about potential effects on migratory birds (see **Section 5.4.9.2.2** Traditional Ecological and Community Knowledge).

A total of 97 forest and grassland bird species were detected within all study areas, including five species of conservation concern: olive-sided flycatcher (Threatened – COSEWIC and *SARA*, Blue-listed) (*Contopus cooperi*), rusty blackbird (Special Concern – COSEWIC and *SARA*, Blue-listed) *(Euphagus carolinus*), barn swallow (Threatened – COSEWIC, Blue-listed) (*Hirundo rustica*), sharp-tailed grouse (Blue-listed) (*Tympanuchus phasianellus columbianus*), and common nighthawk (Threatened – COSEWIC and *SARA*) (*Chordeiles minor*). The areas with the most diverse assemblages of species are located within the transmission line LSA and Kluskus FSR LSA, where surveys at 11 point count stations detected more than 15 species, including one station with 23 species. Locations with the highest diversity typically are associated with wetlands and a mixture of mature and old-growth forests. Olive-sided flycatchers were detected within each of the LSAs, except the mine access road LSA. Habitat where olive-sided flycatchers were detected was in areas where a matrix of old-growth forest and recently harvested areas were adjacent to wetlands. Rusty blackbirds were detected within the transmission line LSA, freshwater supply pipeline LSA, and RSA, and detections occurred in several wetlands primarily around Snake Lake that were surrounded by mature or old-growth forests. Barn swallows were detected at 12 locations within the mine site LSA, transmission line LSA, mine access road LSA, Kluskus FSR LSA, and RSA, including the detection of six nests. Common nighthawks were detected at nine locations within the mine site LSA, transmission line LSA, freshwater supply pipeline LSA, and RSA; most detections occurred at wetlands, although one individual was observed flying over the exploration road west of the exploratory mine camp. Sharp-tailed grouse were detected at four locations, all within the RSA northeast of Mount Davidson; however, no lakes were found.

A total of 18 species of raptors were detected during baseline wildlife surveys, including two species of conservation concern, the short-eared owl (Special Concern – COSEWIC and *SARA*, Blue-listed) (*Asio flammeus*) and the rough-legged hawk (Special Concern – COSEWIC and *SARA*, Blue-listed) (*Buteo lagopus*). The highest diversity of raptors within the areas surveyed occurred within the RSA, where 14 species were detected. The majority of diurnal raptor sightings were made within the SBS Babine Moist Cold variant (SBSmc2) and SBS Kluskus Moist Cold variant (SBSmc3). Breeding was confirmed for osprey (*Pandion haliaetus*) and red-tailed hawk (*Buteo jamaicensis*), both within the Kluskus FSR LSA; however, all of the raptor species detected, except rough-legged hawk, potentially breed within the Project area.

The wildlife habitat suitability ratings identified moderate and high value habitat of forest and grassland birds within the Project area. Clark's nutcracker was identified as a sensitive species after consultation with regulators and detailed surveys focused on documenting the presence of nutcrackers and their habitat in the Project area. The Project footprint was overlaid on the identified habitat to determine the quantity and quality of habitat that will be affected and to develop mitigative measures to reduce Project effects.

#### 5.1.3.4.5 Water Birds

Water birds are of some importance to local residents and Aboriginal groups. Some water birds are harvested by Aboriginal groups in the area. Historically, the water birds were captured using fishing nets suspended in the air, while swans were captured in snares. Some bird body parts had secondary purposes; for example, dried goose esophagi were used for storing fat (Hall, 1992).

Ducks continue to be harvested by Aboriginal groups (see **Section 5.4.8.2.2** Traditional Ecological and Community Knowledge).

A total of 23 species of water birds were detected within all study areas, including one species of conservation concern, the Blue-listed great blue heron (*Ardea herodias*), which was detected in August. The four most frequently detected species include Wilson's snipe (*Gallinago gallinago*), greater yellowlegs (*Tringa melanoleuca*), bufflehead (*Bucephala albeola*), and common loon (*Gavia immer*). Many of the wetlands across the Project area were found to have greater yellowlegs or Wilson's snipe; bufflehead or common loon were present on most waterbodies. Overall diversity was low, with only one or two species occurring on most wetlands. Diversity was highest in wetlands and waterbodies around Snake Lake, where a colony of Bonaparte's gulls (*Chroicocephalus Philadelphia*) was found and breeding of several waterfowl species was detected. One great blue heron was detected within the RSA, where it was found feeding in Davidson Creek on the Mills Ranch. Sandhill cranes (*Grus Canadensis*), which are Yellow-listed in BC, were detected at several locations within the RSA, including a flock found during fall migration at Mills Ranch.

Breeding surveys for the yellow rail, a species of conservation concern, were completed after consultation with regulators; however, none were detected. Habitat suitability modelling was completed for this species during the effects assessment.

#### 5.1.3.4.6 Mammals

The majority of furbearer tracks within the RSA were detected near the mine site at lower elevations. One Blue-listed wolverine (*Gulo gulo*) was detected within the SBS Babine Moist Cold variant (SBSmc2), at the edge of an old-growth forest and mature forest. Ground-based winter surveys identified nine mammal species; the most frequently detected species within the LSA and RSA was moose (*Alces alces*), followed by snowshoe hare (*Lepus americanus*), lynx (*Lynx canadensis*), and wolf (*Canis lupus*). Most ungulate and furbearer aerial sightings were detected in the lower elevation lodgepole pine forest and cutblocks, and along the riparian corridors of the SBSmc2 variant within the RSA. During the ground transects, most furbearer tracks were found in immature pine forest, followed by mature pine forest. Mature spruce and subalpine fir forests had relatively few tracks. One alpine survey was undertaken; however, the hard windblown conditions were not suitable for tracking.

The most frequently observed ungulate was moose, in the lower elevation pine habitats and cutblocks, and along riparian corridors within the RSA. No caribou (*Rangifer tarandus caribou*) tracks were detected during the winter surveys. Wildlife and winter wildlife habitat values were considered moderate and the area did not appear to provide any high value or high use wintering habitat for ungulates. However, use may be determined by annual snow levels and annual availability of food.

Caribou scat was incidentally detected during field surveys within the mine site LSA and RSA during the 2011 to 2013 field surveys. Eight detections of caribou sign occurred within the mine site, four within the ESSFmv1 variant and four within the SBSmc2 variant. Within these variants, caribou were detected in pine-dominated forest.

Arboreal and terrestrial lichen surveys were conducted within the mine LSA and RSA to determine which BGC zones and variants are rated as high value as a potential source of caribou forage within the Project area. High value terrestrial lichen areas were mostly located in relatively pure lodgepole pine forest and clustered between forest ages of two distinct categories: 61 to 80 years and 141 to 250 years. Only moderate and low value arboreal lichen polygons were identified and when VRI data were used to determine any similarity in environmental variables between moderate transects that separated them from low value; however, none could be determined. The lichen forage areas were used during the effects assessment to validate potential important habitat for caribou.

Grizzly bear (*Ursus arctos*) and black bear (*U. americanus*) were detected infrequently within the Project area. Black bears were found across several study areas, and are likely present within the Project area. They were most frequently detected within recently harvested areas, where food resources, such as berries and new plant growth, may be more abundant. Grizzly bears were detected within the mine site and the RSA, along Creek 661, Chedakuz Creek, and southeast of Snake Lake. At least five grizzly bears were detected during the bear-Kokanee camera surveys, and the former two creeks appeared to be favoured due to the presence of spawning Kokanee. Several females with cubs were also detected incidentally, indicating that breeding occurs within the Project area. Four potential bear dens were located at the edge of the mine site LSA in close proximity to each other.

Acoustic bat surveys detected nine species of bat, including three species of conservation concern, within the Project area: little brown myotis (Endangered – COSEWIC) (*Myotis lucifugus*), northern myotis (Endangered – COSEWIC and Blue-listed) (*M. septentrionalis*), and Eastern red bat (Red-listed) (*Lasiurus borealis*). These species were detected in the SBSmc2 and ESSFmv1 variants, and within the mine site LSA, freshwater supply pipeline LSA, airstrip LSA, and RSA. The total number of all bat species detected within the two variants was almost equal. Surveys occurred within the mine site LSA, freshwater supply pipeline LSA, airstrip LSA, and RSA; however, all species of conservation concern were detected within each study area and are likely found across the Project area. Most detection occurred at wetlands, with a mixture of open water and fen surrounded by mature or old-growth forests, although detections within the airstrip LSA occurred within a regenerating forest. A large number of little brown myotis detections occurred at the headwaters of Davidson Creek indicating the potential for a nursery colony nearby.

Wildlife habitat suitability ratings identified moderate to high value habitats for mammal species within the Project area. The Project footprint was overlaid on the identified habitat to determine the quantity and quality of habitat that will be affected and to develop mitigation measures to reduce Project effects (**Section 12.2.1.18.4.6**). Anticipated Project effects include habitat loss (e.g., cleared vegetation, changes to habitat quantity and quality) and some potential degradation. The construction of the proposed mine site, access roads, transmission line, freshwater supply pipeline, and airstrip will require the removal of vegetation and may affect hydrologic conditions and wetlands. A small amount of vegetation will be lost permanently (greater than 100 years), while the majority of other areas will be reclaimed progressively or during closure.

#### 5.1.3.4.7 Invertebrates

A total of 85 species of butterfly and dragonfly were detected within the Project area, including three species of conservation concern: Hagen's bluet (Blue-listed) (*Enallagma hageni*), Jutta Arctic (Blue-listed) (*Oeneis jutta chermocki*), and Assiniboine skipper (Red-listed) (*Hesperia assiniboia*). The highest diversity was located within the RSA with 64 species, followed by the mine site LSA with 46 species. All three species of conservation concern were detected within the mine site LSA and the RSA. Assiniboine skipper and Jutta Arctic were detected within the transmission line LSA and the skipper was also detected within the airstrip LSA. All of the Hagen's bluet detections occurred within wetlands dominated by sedges with large areas of standing water. Assiniboine skippers were primarily associated with recently harvested areas and regenerating forest, and Jutta Arctic detections occurred primarily within wetlands surrounded by mature pine or fir-spruce forests. The habitat associations identified during baseline surveys were used to develop habitat suitability in the Project area in order to determine how potential Project activities would affect invertebrates and their habitat.

#### 5.1.3.4.8 Rare and Listed Species

One of the criteria for selecting a VC, and therefore designing the baseline survey, was to document species of conservation concern, as identified by the *SARA*, Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and BC Conservation Data Centre (BC CDC, 2014), in the Project area. Locally rare species, such as Clark's nutcracker, which is closely associated with Blue-listed and federally endangered whitebark pine (COSEWIC and *SARA*), were included in baseline surveys after consultation with regulators. With the exception of moose, all wildlife VCs include a species of conservation concern. Baseline information for rare and listed species was gathered through detailed surveys and incidental surveys.

#### 5.1.3.4.9 Species of Importance to Humans

Socio-economic importance is one of the criteria used to select VCs and design baseline surveys. Moose, caribou, grizzly bear, furbearers, and some forest and grassland birds and water birds were identified primarily because of their importance to Aboriginal groups, regulated hunters, and recreationalists in the local and regional communities. Further information is included in **Section 7** regarding assessment of socioeconomic effects within the use of lands for traditional purposes.

Wildlife species of importance to the local economy, local communities, and Aboriginal groups were identified through consultation activities (**Section 3** and **Section 17**). Wildlife species identified during consultation include moose, caribou, grizzly bear, black bear, amphibians, furbearers (e.g., marten), and various avian species (e.g., sharp tailed grouse). This information, consistent with the BC EAO guidelines, informed the evaluation and selection of VCs (**Section 5.4.1**) and therefore species of importance to humans were either assessed directly (e.g., caribou) or indirectly where they were represented by another VC.

Potential effects on species of importance to humans were identified based on the Projection Description and proposed activities (**Section 2.2**) and the collected baseline data (**Section 5.1.3.4** and associated appendices). Potential effects to these species are presented in **Sections 5.4.7.3, 5.4.8.3, 5.4.9.3, 5.4.10.3, 5.4.11.3, 5.4.12.3, and 5.4.13.3** and include, depending on the species, habitat loss/modification, habitat fragmentation, change in predator/prey dynamics and sensory disturbance. The temporal bounds of the potential effects are considered by project stage from construction through to post-closure and within the established spatial boundaries defined in **Section 4.3.1.1** (Spatial Boundaries). Mitigation identified during the assessment of potential effects including measures to avoid effects, mitigate for wildlife habitat losses and compensation for trapline holders, where required, is presented in **Section 12.2.1.18.4.6** Wildlife Management Plan, **Appendix 5.3.7A** Conceptual Wetlands Compensation Plan, and **Section 20** Summary of Mitigation Measures.

Fish species of value to Aboriginal groups, including rainbow trout, kokanee, whitefish, sucker species, char, burbot, salmon including sockeye salmon and white sturgeon are identified in **Section 5.3.8.2.12** Traditional Knowledge. Potential effects on these species including changes in water quality, stream and habitat availability is discussed in **Section 5.3.8.3** by project phase. Mitigation measures are identified in **Section 12.2.1.18.4.2** Aquatic Resources Management Plan, **Section 12.2.1.18.4.21** Fish Salvage Plan, and **Appendix 5.1.2.6C** Fisheries Mitigation and Offsetting Plan.