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5.4.11 Caribou (*Rangifer tarandus*)

5.4.11.1 Introduction

This section assesses the potential effects of the Project on the caribou Valued Component (VC). The indicator species is caribou (*Rangifer tarandus*). The assessment is described in the subsections below and has been conducted for this species. This introduction describes the information sources of the assessment and the applicable regulatory framework for the assessment of the VC (**Section 5.4.11.1**). The spatial, temporal, administrative, technical boundaries and assessment approach is described in (**Section 5.4.11.3**).

Woodland caribou (*Rangifer tarandus caribou*) of British Columbia (BC) are classified by the province into three ecotypes (boreal, northern, and mountain). The northern ecotype inhabits areas with low to moderate snow depths in the boreal forests of the north and west-central regions of BC, including the areas of Tweedsmuir and Entiako. In these areas, caribou forage primarily on terrestrial lichens; arboreal lichen use increases as winter progresses or during winters of deep snowpack (Bergerud, 1974a; Seip, 2002). The proposed Blackwater Gold Project (the Project) has potential to directly affect the Tweedsmuir-Entiako subpopulation and indirectly affect the Itcha-Ilgachuz subpopulation of northern caribou.

Caribou are year-round residents within the Project area and are dependent on mature and old coniferous forests, although deciduous and mixed forests are also used to satisfy their life requisites (Cichowski, 1993). Pre-existing habitat loss and fragmentation due to logging and road development have altered the amount of potential habitat within the Project area. Caribou was selected as a Valued Component (VC) because of declining subpopulations in the region as well as caribou's sensitivity to disturbance, wide-ranging distribution, and cultural and management status to First Nations and other BC residents. The Southern Mountain population of caribou is protected under the *Species at Risk Act (SARA)* (Government of Canada, 2002), and the recovery and survival of this population are identified in the Caribou Recovery Strategy for the Woodland Caribou, Southern Mountain Population (*Rangifer tarandus caribou*) in Canada (Environment Canada, 2014).

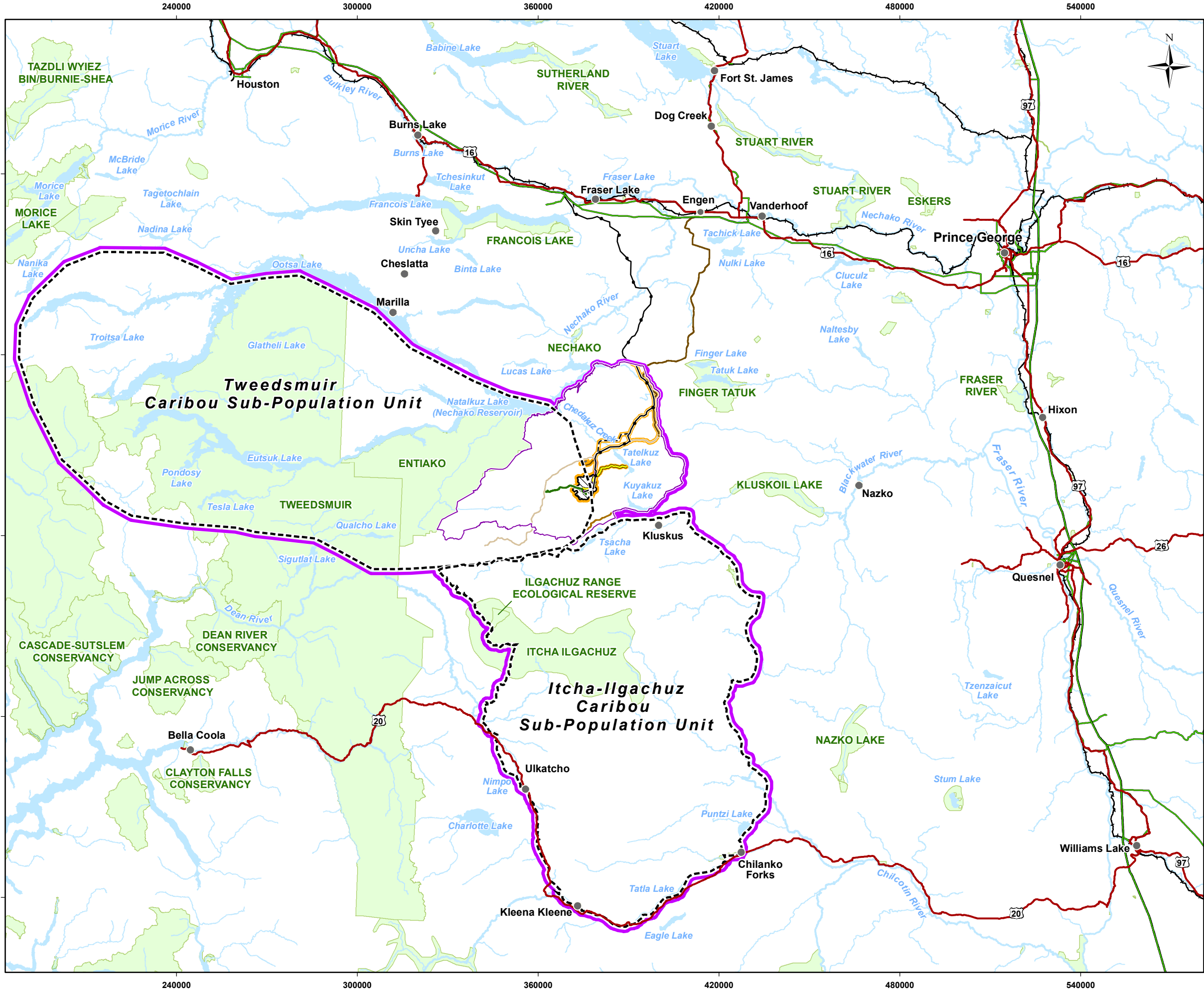
The Tweedsmuir-Entiako and Itcha-Ilgachuz caribou subpopulations are part of the Threatened Southern Mountain Population/Northern Group (Environment Canada, 2014) of Northern Mountain DU7 (COSEWIC, 2011), and part of the provincially Blue-listed northern ecotype (BC Conservation Data Centre (BC CDC), 2014) (The Tweedsmuir subpopulation is a local population unit and Itcha-Ilgachuz subpopulation is a component of the Chilcotin local population unit within the northern group of the Southern Mountain Population as per Environment Canada 2014). To avoid confusion in this document, caribou subpopulations will be referred to by their respective subpopulation name. The Tweedsmuir-Entiako subpopulation consists of approximately 300 caribou; the Itcha-Ilgachuz subpopulation has approximately 1,700 caribou and typically spends the summer in high elevation areas, while migrating into forested lower elevations for the winter (Environment Canada, 2014; Cichowski and Banner, 1993) (**Figure 5.4.11-1**). Both subpopulations have a declining population trend (Environment Canada, 2014). The Southern Mountain Caribou Recovery Strategy (Environment Canada, 2014) identifies critical habitat for the subpopulations that correspond to

previously identified Ungulate Winter Ranges (UWR) and Type I Matrix Habitat which corresponds to the current range of the subpopulations (**Figure 5.4.11-2**).

Summer and winter ranges of caribou are often separate and distinct areas linked by migration corridors. Lance and Mills (1996) described the physical and botanical characteristics of spring migration habitats for the Tweedsmuir-Entiako subpopulation. Raised and open aspects, sparse tree cover, free-draining soils, and simple flora with abundant terrestrial lichens characterized all habitats (Lance and Mills, 1996).

In winter, the majority of northern caribou forage predominantly on terrestrial lichens in the lodgepole pine–dominated, mature/old-growth forests of the Montane Spruce (MS) and Sub-Boreal Pine – Spruce (SBPS) biogeoclimatic (BGC) zones. As snowpack deepens in late winter, caribou increase their use of arboreal (tree) lichens. A minority of the caribou population winter on windswept subalpine and alpine slopes where they feed mainly on terrestrial lichens supplemented with arboreal lichens on trees near the treeline. Snow depth and density can affect the availability of caribou winter forage. Deep snow may prevent digging for terrestrial lichens, while crusted snow may provide a platform to help reach arboreal lichens. Yearly variations in snow depth and density may be reflected by changes in patterns of caribou winter range use. Cichowski (1993) reported that, in some years, caribou of the Itcha-Ilgachuz subpopulation would forage extensively during the fall in Fescue – Lichen meadows, Altai fescue – Cladonia dry grassland, and Timber oatgrass – Altai fescue cold dry meadows but in other years with heavy snow loading abandoned these habitats in favour of lichen forests. This occurs when snow depths approached 50 cm with caribou sinking depths of 40 cm. Caribou display two different habitat-use strategies during winter. Some winter in the mature/old-growth forests of the Engelmann Spruce – Subalpine Fir (ESSF) zone and on the open, windswept alpine habitats with reduced snow accumulation giving access to terrestrial lichens by cratering; others winter at lower elevations in the extensive lodgepole pine–dominated, mature/old-growth forests where terrestrial lichens are abundant and accessible if snow depths are not limiting.

In spring, summer, and fall, caribou have a more varied diet of graminoids, forbs, shrubs, mosses, and fungi in forests, wetlands, subalpine parkland, and alpine tundra (Cichowski et al., 2004; COSEWIC, 2002; Johnson et al., 2004). In spring and summer, caribou feed on a variety of shrubs, forbs, and grasses that are relatively high in protein at this time of year. Lichens may still be eaten during these seasons but are not preferred (Bergerud, 1972; Rominger and Oldemeyer, 1990).



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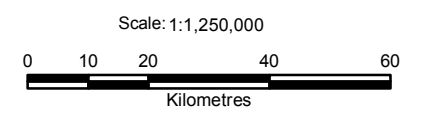
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- Highway
- Kluskus FSR
- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Existing Transmission Line
- Streams
- Waterbody
- Parks and Protected Areas

Project Components

- Exploration Road
- Proposed Mine Access Road
- Proposed Transmission Line
- Proposed Transmission Line re-route
- Proposed Water Pipeline Route
- Proposed Airstrip Access Road
- Proposed Airstrip Extent
- Proposed Mine Site

Caribou

- Caribou Local Study Area
- Caribou Regional Study Area
- Area Used for Habitat Loss and Alteration Analysis
- Caribou Sub-Population Unit



Reference
 BC Government GeoBC Data Distribution
 Caribou Sub-Population Units are shown only for features used in analysis

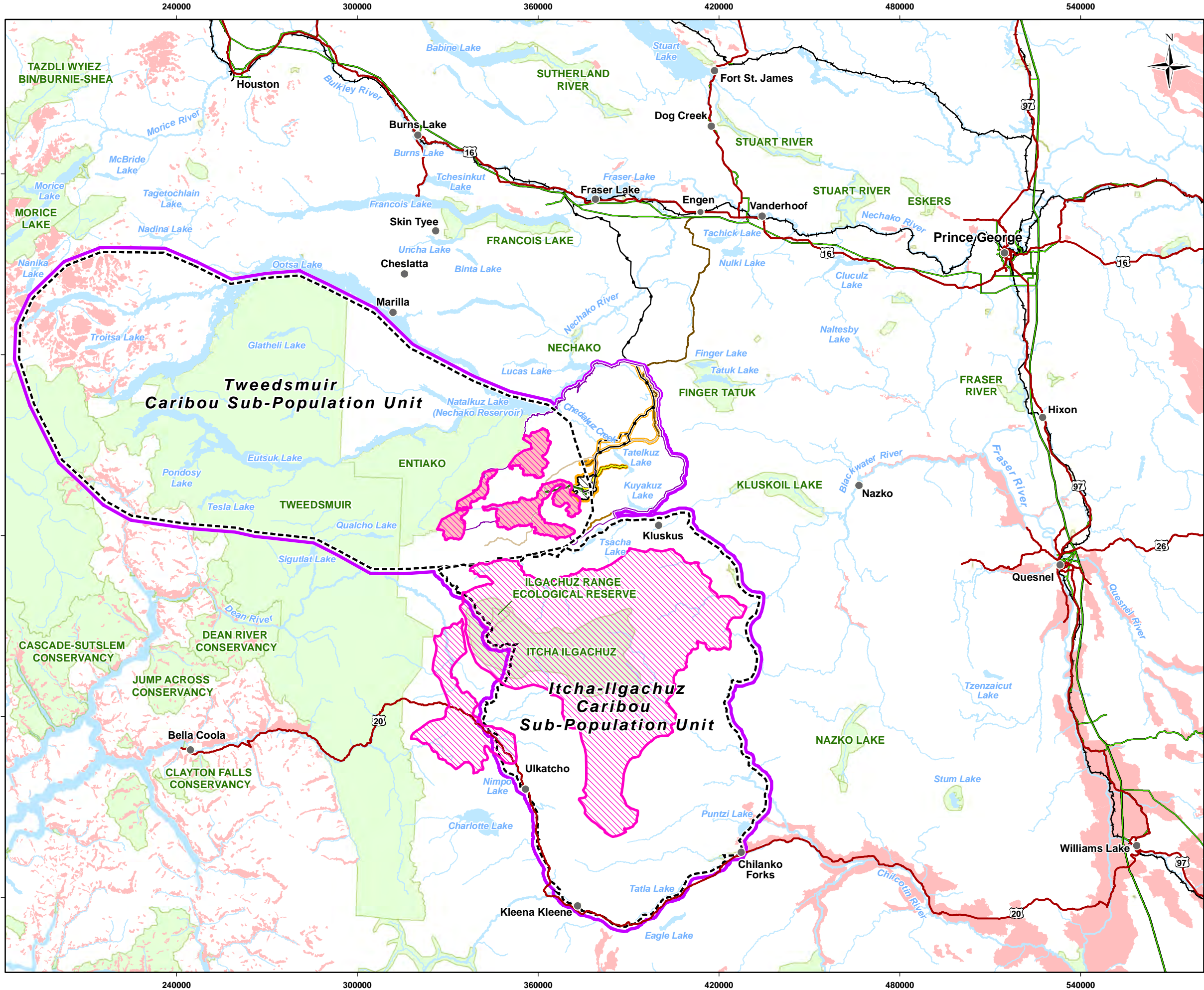
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PROJECT: **Blackwater Gold Project**

Regional Study Area Boundaries and Subpopulation Boundaries for Caribou and Habitat

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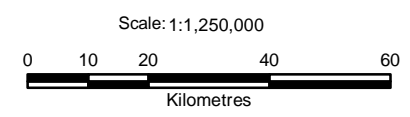
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- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Existing Transmission Line
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Caribou

- Caribou Local study Area
- Caribou Regional Study Area
- Area Used for Habitat Loss and Alteration Analysis
- Caribou Sub-Population Unit
- Caribou Critical Habitat(High/Low Elevation Range)
- Ungulate Winter Range



Reference
 BC Government GeoBC Data Distribution
 Caribou Sub-Population Units are shown only for features used in analysis

CLIENT: **newgold™**

PROJECT: **Blackwater Gold Project**

Environment Canada (2014) Critical Habitat (and Type I Matrix Habitat) for Caribou Subpopulations

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BLACKWATER GOLD PROJECT

APPLICATION FOR AN
ENVIRONMENTAL ASSESSMENT CERTIFICATE /
ENVIRONMENTAL IMPACT STATEMENT
ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS



To avoid contact with predators, caribou use security habitat where, if threatened, they can escape by fleeing. The primary strategy of predator avoidance is to space out and live in low densities so that running into a predator is less likely (Bergerud, 1992; Bergerud et al., 1990). Seip (1992) attributed major declines in caribou populations of central BC to increases in numbers of moose in the 1920s. The presence of moose supports increased wolf numbers and results in higher predation levels on caribou (Seip, 1992; Seip and Cichowski, 1996). Rugged, exposed alpine/subalpine terrain provides caribou with the best security habitat where they can spatially separate from other prey species and best detect and avoid predators (Poole et al., 2000). Large frozen lakes and wetlands adjacent to forest stands are used as escape terrain because caribou are better adapted to travel through deep snow than are their predators (Cichowski, 2010). To reduce predation on calves, northern caribou disperse widely throughout rugged, exposed terrain above the treeline. They also use this dispersal strategy in forested habitats (Bergerud et al., 1984; Hatler, 1986; Cichowski, 1993). However, calf survival rates are higher in rugged, mountainous terrain where cows and calves can distance themselves from other prey species and predators (Seip and Cichowski, 1996).

In both forested and non-forested habitats, caribou need large tracts of land, often referred to as matrix habitat, through which they can disperse to reduce predation levels (Bergerud et al., 1984). While most caribou range within a discrete area during each winter, they may not return to the same area the following year.

The **Tweedsmuir-Entiako subpopulation** has been studied since the mid-1980s. Habitat selection and seasonal movements of the subpopulation were monitored from 1982 to 1984 by Marshall (1985) and Smith and Herbert (1987). Cichowski (1989) followed the subpopulation from 1985 to 1988. From 2006 to 2009, Cichowski (2010) followed the subpopulation and compared the movements to all of the previous years of radio telemetry to identify any changes in movements that may have been caused by mountain pine beetle (MPB), *Dendroctonus ponderosae*, infestation. Up until 2009, no significant alteration had been noted in the seasonal movement, range occupancy, and habitat use during the MPB infestation (Cichowski, 2010). Most areas of high habitat suitability for this subpopulation are protected by low and high elevation ungulate winter range (UWR); however, high elevation winter habitat is limited for the subpopulation, and its maintenance is important over the long term. The Caribou Recovery Strategy (Environment Canada, 2014) identifies critical habitat that includes high elevation winter range and sets a target of 65% undisturbed matrix habitat. Historical radio telemetry data between 1983 and 2003 (Cichowski, 2010) indicate that some collared individuals of the Tweedsmuir-Entiako subpopulation were occasionally found outside the western edge of the mine site Local Study Area (LSA) within the designated UWR. No caribou were observed during baseline surveys; however, scat was found at several locations within the mine site LSA (along the Davidson Creek corridor and once in the subalpine of Mount Davidson). No caribou tracks were found during winter track surveys of the Project study area in 2012 (Ecofor, 2012; AMEC, 2013). The mine site LSA appears to be used incidentally during late spring, summer, and fall. There are no documented movement corridors between the Tweedsmuir-Entiako and Itcha-Ilgachuz subpopulations, but suitable caribou habitat in the area is considered matrix habitat and is documented in the effects assessment. Field studies of the Tweedsmuir-Entiako subpopulation occurred from 2006 to 2009. The study analyzed the effects of the MPB on the distribution of caribou and found that seasonal

range movements, range use, and habitat by the caribou subpopulation were similar to that recorded by them prior to the MPB infestation. The MPB infestation has killed extensive pine stands that provided substrate and microclimate needed for terrestrial and arboreal lichens. The subpopulation uses Entiako Park during winter and moves to Tweedsmuir Park for summer, with no seasonal movement corridors including the mine LSA. They may use the Tweedsmuir Park area as part of their wintering habitat during high snowpack years (Cichowski, 2010).

The **Itcha-Ilgachuz subpopulation** is found south of the mine site Regional Study Area (RSA) (**Figure 5.4.11-1**) (Young and Roorda, 1999) but is considered potentially important as a metapopulation historically linked to the Tweedsmuir-Entiako subpopulation (Youds et al., 2011; Hebert, 2013, pers. comm.). The Itcha-Ilgachuz subpopulation inhabits an area of approximately 10,042 square kilometres (km²) in the Itcha-Ilgachuz Provincial Park and surrounding areas in the rain shadow of the Coast Mountains south of the Blackwater River (Cariboo Chilcotin Land Use Plan (CCLUP) Caribou Strategy Committee, 2002). During summer, the Itcha-Ilgachuz subpopulation is associated with high elevation, dry alpine landscapes with little vegetation productivity or forest cover as well as with old-growth subalpine fir forest (Apps et al., 2001). During winter, the alpine-dwelling animals are associated with high elevation, dry landscape with little forest cover while low elevation animals prefer closed canopy lodgepole pine forest. The majority of both telemetry and survey observations were located within the Itcha-Ilgachuz Mountains (Young and Roorda, 1999). The telemetry and observation dataset from 1995 to 1999 shows that only one location out of 3,261 telemetry points and one location out of 722 observation points were north of the Blackwater River (Young and Shaw, 1998a, 1998b). The one telemetry point was southwest of the RSA, upstream of Tatelkuz Lake, and the one survey observation was northwest of Laidman Lake (BC MOE, 2013a). The area used by the Itcha-Ilgachuz subpopulation appears to be increasing over time based on more recent telemetry work, although not currently overlapping with the Project RSA (Nicole Freeman, 2013, pers. comm.). However, it is not known whether this expansion would increase the probability of Itcha-Ilgachuz subpopulation mixing with the Tweedsmuir-Entiako subpopulation (Nicole Freeman, 2013 pers. comm.).

The proximity of the Tweedsmuir-Entiako subpopulation and Itcha-Ilgachuz subpopulation and the suitable matrix habitat between them is considered important for future sustainability of the subpopulations and is included in the assessment of potential Project effects.

The Vanderhoof Land and Resource Management Plan (LRMP) (Integrated Land Management Bureau (ILMB), 1997) describes a number of wildlife objectives and strategies for maintaining habitat quality for caribou (and other wildlife) through establishment of resource management zones (RMZs). The Laidman Lake RMZ, which is located in the western portion of the mine site RSA, is described in the Vanderhoof LRMP as comprising moderate or low quality terrestrial lichen habitat, but the northwestern portion of the UWR tends to have higher quality suitable lichen habitat (Yaremko and Sulyma, 2005). However, the Laidman Lake RMZ is an integral part of the entire wintering range for the Tweedsmuir-Entiako subpopulation, providing caribou with alternative terrestrial lichen habitat, arboreal lichen habitat, and movement corridors (ILMB, 1997).

5.4.11.1.1 Regulatory Considerations

Caribou are subject to provincial wildlife regulations under the *Wildlife Act* (Government of BC, 1996) and are a Blue-listed species (BC CDC, 2014). The Southern Mountain population of caribou is designated as Threatened under *SARA* (Government of Canada, 2002). Management of caribou habitat and populations is considered under the *Forest and Range Practices Act* (Government of BC, 2002), Conservation Framework (BC Government, 2014), and Vanderhoof LRMP (ILMB, 1997) (see **Table 5.4.11-1**).

Table 5.4.11-1: Regulatory Considerations Regarding Caribou

Statute/ Guideline	Brief Description or Requirements	Data Required to Meet Regulation/Guideline	Timeframe
Canada <i>Species at Risk Act</i>	Species at risk may require federal permits for take of the species. The Caribou Recovery Strategy sets targets and mitigation objectives for critical habitat and recovery (Environment Canada, 2014).	Occurrence and abundance/distribution data from surveys. Habitat assessment based on Caribou Recovery Strategy criteria. Assessment of project related and cumulative effects to habitat in subpopulation ranges.	Ongoing monitoring of mitigation measures. Caribou management plan for exploration, construction, and operations.
BC <i>Wildlife Act</i>	Permits are required for handling animals and for surveys that may harass animals.	Abundance and distribution data from BC CDC records and surveys, wildlife habitat suitability mapping, and participation in collaring and/or surveys of caribou.	Wildlife management plans. Wildlife permits for surveys and collaring.
BC <i>Forest and Range Practices Act</i>	UWRs require special management.	Impact assessment and proposed mitigation/offsets required to assess habitat loss to old-growth and UWR areas, both of which can include important protected habitat for caribou.	Wildlife management plans and permitting for exploration.
LRMP Resource Management Zones	The Vanderhoof LRMP (ILMB, 1997) presents a number of wildlife objectives and strategies for maintaining habitat quality for caribou.	Supporting scientific research opportunities (e.g., predator-prey relationships, monitoring and comparing vegetation succession of controlled burn areas versus wildfire areas); periodically inventorying wildlife populations; protecting high quality caribou habitat from destruction (short term); developing a winter habitat strategy to ensure caribou has wintering grounds over the long term; implementing a fire management plan.	Wildlife management plans and permitting for exploration.
BC Conservation Data Centre	The Tweedsmuir-Entiako subpopulation is provincially Blue-listed.	Habitat and population data related to Project and subpopulation area	Ongoing

Note: BC CDC = British Columbia Conservation Data Centre; ILMB = Integrated Land Management Bureau; LRMP = Land and Resource Management Plan; UWR = Ungulate Winter Range

5.4.11.2 Valued Component Baseline

Baseline information collected during surveys and incidental observations in the Project area is provided in **Appendix 5.1.3.4A**. Reconnaissance baseline surveys did not note any caribou; however, incidental detections of sign during other surveys indicated limited caribou use in the mine site LSA (**Figure 5.4.11-1**). No detections of caribou were recorded for the linear components. Baseline detections and number of individual mammals during 2011-2013 surveys of each LSA and the RSA of the Project are presented in Table 3.5-1 (**Appendix 5.1.3.4A**).

In 2013, Cichowski conducted fall surveys of the two caribou subpopulations, which showed low levels of recruitment (i.e., low number of surviving calves relative to the number of adult cows) (Cichowski, 2013) (**Appendix 5.4.11A**). The Tweedsmuir-Entiako subpopulation had a total of 94 caribou in five groups in the Quanchus Mountains. All caribou were found in the Mount Wells/Tweedsmuir Peak and Wells Gray Peak mountain blocks. Fall calf survival was 10.6% calves (percentage of the total survey count) and 16.7 calves/100 cows. The bull cow ratio was 40 bulls/100 cows, suggesting that there were sufficient bulls to breed all cows and that the low calf count was likely not due to low pregnancy rates. The calf recruitment rate, below what caribou experts suggest is necessary to maintain a sustaining population, supports the Environment Canada (2014) characterization of a declining population trend for this subpopulation, which is currently assessed at a minimum viable population size threshold of 300 (Environment Canada, 2011).

According to the Ministry of Environment caribou survey reports (Cichowski, 2013), the Itcha-Ilgachuz population declined by approximately 52% between 2003 and 2010, which is believed to be due to low calf recruitment and predation of adults. The October 2013 survey sample of 616 caribou resulted in an age ratio of 3.4 calves/100 cows, which is considerably lower than fall ratios of 20–30 calves/100 cows, a minimum ratio for sustaining herd numbers. Combining the October 2012 fall ratio with the previous recruitment ratios (2003 to 2012) suggests that the Itcha-Ilgachuz population is continuing to decline rapidly. Based on a ratio of 3.4 calves/100 cows in October 2013, the recruitment rate by spring 2014 will likely be close to 0 yearlings/100 cows (Cichowski, 2013) (**Appendix 5.4.11A**). The Caribou Recovery Strategy (Environment Canada, 2014) states that current population trends in both the Tweedsmuir-Entiako and Itcha-Ilgachuz subpopulations are declining and identifies critical habitat and performance indicators for achieving population and distribution objectives of the Caribou Recovery Strategy.

5.4.11.2.1 Past, Present, or Future Project Activities

The projects or activities considered in the assessment are in the Project Inclusion List (PIL). The PIL identifies those projects or human activities that may overlap spatially or temporally with the Project summarized in **Section 4 Table 4.3-11. Appendix 4C** presents the detailed Project Inclusion List and descriptions of various projects and activities used for assessing potential environmental effects.

Pre-existing habitat loss and fragmentation due to logging and road development have altered the low elevation habitat within the Project area. The MPB infestation has affected large areas of

mature pine forest in the region including the LSA and RSA, which has resulted in a loss of caribou habitat, some of which was harvested while remaining forests are in various stages of degeneration due to MPB (Armleder and Waterhouse, 2008). Mineral exploration in the area has increased the number of access roads, resulting in increased habitat fragmentation and increased access for predators. There is no hunting season in the Project area; however, the area is used by recreationalists who may impact caribou by disturbance and displacement (BC Ministry of Forests, Lands and Natural Resource Operations (BC MFLNRO), 2013; Seip et al., 2007, Wilson and Hamilton, 2003; Freeman, 2008). Caribou baseline information was collected in the LSA and portions of the RSA that were altered by these past and present activities.

Forest fire and forest insects are the primary natural disturbances in low elevation winter ranges of the Itcha-Ilgachuz and Tweedsmuir-Entiako caribou subpopulations (Environment Canada, 2014). Fire directly alters habitat through loss of mature conifer stands, lichens, and other forage plants and may create barriers to movement (Environment Canada, 2014). Indirectly, fire transforms mature and old forests into early seral habitat favoured by moose and deer, resulting in increased wolf densities and in potentially increased caribou mortality risk (Seip, 1992; Stotyn, 2008). Historically, following a wildfire, caribou would shift their use of habitat from affected areas to more suitable areas (Cichowski, 2010). Barrier effects to this movement pattern depend on intensity of the burn and fire size. Caribou have evolved in a fire-driven landscape; they will use burns depending on amount of unburned patch retention and will readily cross small burns (Environment Canada, 2014). Fire is a natural mechanism for habitat renewal, but the important consideration is the cumulative creation of early seral habitats by fire disturbance where it interacts with significant amounts of human disturbance to a level that affects predator-prey dynamics (Environment Canada, 2014). Browse-rich early seral habitats are attractive to other ungulate species and their associated predators, which can result in increase predation risk to caribou depending on numerical response of predators to the prey base (Seip, 1992; Stotyn 2008). With the increase of industrial and agricultural activities, there are fewer suitable areas of caribou habitat. Disturbance threshold analysis by Environment Canada (2014) concluded that anthropogenic disturbance had a greater effect than natural disturbance on probability of persistence at the caribou population range scale.

MPB infestation has affected most low elevation winter ranges in the Project area. MPB may affect caribou through the loss of terrestrial and arboreal lichen habitat, as other species replace lichens after the death of pines (Cichowski, 2010). Although initially dwarf shrub abundance increased and terrestrial lichen abundance declined following MPB infestation (Cichowski et al., 2008; Cichowski et al., 2009; Seip and Jones, 2010; Waterhouse, 2011), abundance of dwarf shrubs has since declined and terrestrial lichen abundance has increased slightly.

5.4.11.2.2 Traditional Ecological and Community Knowledge

Caribou are important to local residents and Aboriginal groups. Comments and concerns raised during the engagement and consultation process provided insight into traditional, ecological, and community knowledge regarding caribou (**Section 3**). Aboriginal groups continue to harvest caribou. Caribou hunting historically occurred on the south side and summit of Mount Davidson (Lhoosk'uz Dene Trapline holder, 2013, pers. comm.). Lhoosk'uz Dene Nation representatives

described how caribou were herded into snowdrifts and then killed and butchered immediately where captured. Lhoosk'uz representatives noted that prior to the 1930s, caribou populations were prosperous in the area. These numbers have since declined, although the representatives have recently observed a slight increase in the number of caribou sighted (Lhoosk'z Dene Trapline holder, 2013, pers. comm.). Caribou were described by Lhoosk'uz representatives as typically living in higher ground areas, which can make them more costly and time-consuming to hunt. Ulkatcho First Nation representatives raised concerns of the effects of MPB and the destruction of lichen habitat. Ulkatcho First Nation representatives continue to express concerns about the potential to exacerbate predator-prey relationships by providing predators (e.g., wolves and grizzly bears) with easier access to caribou populations.

Other community representatives described the caribou population as a “dying one.” Some described Moose Lake and Tweedsmuir Park as popular locations for caribou during winter and summer, respectively. Some guide outfitters expressed concern about the potential effects from noise and human activity on their ability to hunt caribou (**Section 3**).

Further details how the Proponent has responded to issues and concerns raised are presented in Section 3 and Part C of the Application.

5.4.11.3 Potential Effects of the Proposed Project and Proposed Mitigation

This subsection identifies and analyzes potential adverse effects on the caribou VC resulting from the proposed Project's construction, operations, closure and post-closure phases.

It first describes the features of the study area, temporal, administrative, and technical boundaries. (**Section 5.4.11.3.1 to Section 5.4.11.3.5**).

Then, **Section 5.4.11.3.6** details the assessment approach used in the assessment followed by **Section 5.4.11.3.8** Mitigation Measures.

The assessment considers the following:

- Habitat, including the quality and quantity of any lost habitat for relevant species;
- Feeding, or breeding habitats;
- Any wetland habitats important to caribou with alteration or loss;
- Barriers to caribou, including the roads developed as part of the mine and their potential effects on wildlife movements;
- Disturbance of daily or seasonal wildlife movements (e.g., migration and home ranges), which would include potential hazards and conflicts associated with mine access and travel corridors of caribou;
- Caribou are listed under provincial Blue lists, SARA, COSEWIC, as well as, being a species of international significance (**Section 5.4.11.1.1**);
- Direct and indirect mortality of species through increased hunting opportunities or improved access for predator species;

- Potential implications to predator – prey dynamics from changes in habitat suitability (e.g., potential changes in wolf numbers or distribution due to habitat and prey abundance changes);
- Caribou habitat is being rated for current suitability as a surrogate for productivity; and
- Implications of the proposed Project acting as an attractant for species that might impact caribou.

A range of potential effects on caribou can be associated with a project involving a mine site, linear features including roads, a water pipeline and an electrical transmission line. Assessment boundaries define the scope or limits of the assessment. The boundaries encompass the areas and time periods during which the Project is expected to interact with caribou (spatial and temporal boundaries), any constraints placed on the assessment of those interactions due to political, social, and/or economic realities (administrative boundaries), and any limitations in predicting or measuring changes (technical boundaries). Each of these boundaries is defined in the subsections below.

Activities occurring during each phase of the proposed Project could potentially interact with caribou. Habitat loss, features that act as attractants, potential mortality, changes in habitat availability, noise disturbance (displacement), changes in predator numbers and predation success, and disruptions of movement are the predicted key and moderate interactions of the proposed Project related to caribou. Taking a conservative approach, both Key and Moderate interactions are combined and considered jointly in assessment of project and cumulative effects.

The Proponent is working with the nearby First Nations and the Southern Mountain Caribou Recovery Plan, and the Province to understand and protect caribou and their habitat. The Proponent is actively participating and supporting caribou and wolf related studies on a regional basis, involving the Tweedsmuir Itcha - Ilgachuz metapopulation. Data from these studies conducted in 2013 were included in the baseline studies and used to inform the effects assessment.

5.4.11.3.1 Study Area Boundaries

Three geographic scales were defined for the study areas considering the Project effects on caribou and caribou habitat, as shown on **Figure 5.4.11-1** and described below. Areas used for collection of baseline information include the LSA and parts of the RSA. Past, present, and future activities that may affect caribou within these areas were identified and assessed within the RSA and caribou subpopulation areas.

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

- Mine Site: Approximate 500 m buffer around the proposed mine site facilities; and
- Transmission line, mine access road, airstrip, freshwater supply pipeline, and Kluskus FSR: approximately 250 m buffer from each side of the linear component boundary.

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

- The LSA includes the entire mine site where habitat will be removed and considers a buffer to take into account sensory disturbances; and
- The LSA includes all linear components and a buffer to take into account sensory disturbances. The buffer along the linear corridors varies because activities along those corridors varies from an access road that may have greater sensory disturbance to a transmission line with limited human activity or traffic after construction.

The LSA for the purpose of the caribou VC comprises 13,016 ha and includes 7,032 ha for the Project footprints (**Table 5.4.11-2**). 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 transmission line includes a mainline route and two potential re-routes, the Mills Ranch and Stellako options. The FSR re-alignment and Transmission Line access roads are included in the LSA area for these features. The LSA for the FSR and Transmission Line only includes areas within suitable caribou habitat. The final location of the transmission line access roads will be determined during the detailed engineering and permitting stage, and will consider traditional knowledge and traditional use information provided by Aboriginal groups as appropriate. Its design will follow the same principles of using existing roads avoiding sensitive habitat to the extent possible.

Caribou response to disturbance varies with disturbance type and magnitude. DeCesare et al. (2012) reported that most (7% to 28%) of home range area is >250 m from linear disturbance. Several authors report the average caribou displacement as 250 m from a linear feature (James and Stuart-Smith, 2000; Dyer et al., 2001; McCutchen, 2007) and that the effects vary with frequency of sensory disturbances such as traffic volume (James and Stuart-Smith, 2000) and density (Nellemann and Cameron, 1998). To address potential disturbance from variable levels of activity, buffers were greatest for the mine site and main access road in or near caribou habitat and less for the transmission line, freshwater pipeline, airstrip and existing Kluskus FSR.

Table 5.4.11-2: Project Component Areas for Caribou

Component	Area (ha)
Mine Site	6,123
Access Road	363
Existing Kluskus Forest Service Road	2,539
Airstrip	465
Freshwater Pipeline	731
Main Transmission Line	2,916
Mills Ranch Transmission Line	924
Total LSA	14,061

Note: ha = hectare; LSA = local study area. LSA for each feature is not exclusive; overlaps are double-counted in Total LSA area.

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

- Mine Site: Includes ungulate winter range established for the Tweedsmuir-Entiako caribou herd (U-7-012). The western and southern edges of the RSA outline these winter ranges. The southwestern boundary follows the Upper Blackwater Management Zone where the RSA then follows the Blue Road until it reaches the Ootsa – Kluskus FSR and follows this north until it reaches the Nechako Reservoir. The northern boundary of the RSA follows the shoreline of the Nechako Reservoir. The northern boundary of the RSA follows the shoreline of the Nechako Reservoir;
- Transmission Line and Kluskus FSR. Approximate 1 km buffer from the linear component boundary; and
- For the caribou RSA the portions of the transmission line and Kluskus FSR located outside of suitable caribou habitat were excluded. Caribou regional effects will also be considered in the context of the Ungulate winter range and both herd areas (Tweedsmuir-Entiako caribou herd and Itcha-Ilgachuz caribou herd).

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

- Extends beyond the mine site LSA to consider natural barriers for wildlife such as large water bodies or watershed divides; and
- The Tweedsmuir-Entiako and the Itcha-Ilgachuz subpopulation ranges were considered for cumulative effects assessment due to concerns expressed by Aboriginal Groups and the sub-working group on caribou in relation to the potential for cumulative effects and to meet the requirements of assessment of impacts to critical habitat in the caribou recovery strategy (Environment Canada 2014).

The RSA for the purpose of the caribou VC includes the caribou subpopulation areas and includes 258,408 ha of habitat that was modeled for suitability. It also differs from the other wildlife RSAs in that it does not include the transmission line corridor and FSR components that are

outside of moderate to high value caribou habitat as directed by the Blackwater EAO Caribou Working Group and BC MFLNRO (**Figure 5.4.11-1**).

Caribou Subpopulation Areas: The Tweedsmuir-Entiako subpopulation (13, 431 km²) is found west of the mine site LSA which has some overlap with the historic eastern range of the subpopulation (**Figure 5.4.11-1**). The Itcha-Ilgachuz subpopulation (9,452 km²) is found south and outside of the mine site LSA; however, it was likely historically connected to the Tweedsmuir-Entiako subpopulation and is considered a potentially linked metapopulation (**Figure 5.4.11-1**). Although the Itcha-Ilgachuz subpopulation is outside of the Project LSA and is south of the area used for analyzing effects of habitat loss and alteration, it is considered because of the potential for future movement among the subpopulations and the matrix caribou habitat within the Project RSA.

5.4.11.3.2 Temporal Boundaries

Temporal boundaries of the Project, which are contingent on permitting, include four primary phases.

- **Construction phase:** The construction phase of the Project will occur over 2 years and will likely start following receipt of the required permits;
- **Operations phase:** The operations phase of the Project will extend for approximately 17 years;
- **Closure phase:** The closure phase is estimated to last approximately 18 years (ending in Year 35); and
- **Post-closure phase:** The post-closure phase starts in Year 35.

In terms of duration of effects, the following terms are used in this effects assessment: Short-term effects occur during the construction phase; Medium-term effects are not applicable for caribou as they were considered long term to provide a conservative assessment; Long-term effects occur throughout operations and closure; and Chronic effects extend into post-closure or beyond.

5.4.11.3.3 Administrative Boundaries

The Vanderhoof LRMP identifies smaller Resource Management Zones (RMZs) that have different resource development and conservation objectives. Each RMZ has a selection of species of management concern and broad objectives to guide land use decisions and management. The mine site and associated infrastructure including the roads and transmission line are located within the following RMZs: Nechako Valley, Nechako West, Upper Nechako River, Vanderhoof South, Crystal Lake, Kluskus, Chedakuz, Davidson Creek, and Laidman Lake. These RMZs have broad habitat objectives that are considered for caribou effects assessment and mitigation to conserve important caribou habitat and minimize potential effects on caribou. Forestry management objectives within the RMZs are suitable for maintaining caribou habitat. The Project is located within five Wildlife Management Units (WMUs): 5-12, 5-13, 6-1, 7-11, and 7-12. Each WMU is the primary designation tool for conservation lands under section 4 of the *Wildlife Act*. Conservation

and management of caribou and their habitats are a priority in the WMUs and are used to set hunting regulations (BC MFLNRO, 2012).

5.4.11.3.4 Technical Boundaries

Technical boundaries for the assessment are established by the accuracy of the wildlife habitat model predictions used in the effects assessment. There is uncertainty associated with the use of habitat suitability models; however, Resource Inventory Standards Committee (RISC) standards for ratings and suitability classes were followed. Therefore, these include acceptable levels of uncertainty for an assessment. Caribou surveys and habitat assessment were completed within the LSA and RSA.

5.4.11.3.5 Potential Project Effects

The assessment of potential Project effects on the Tweedsmuir-Entiako subpopulation within the Project RSA included habitat effects and mortality risk, as well as potential cumulative effects related to the objectives of the *Recovery Strategy for the Woodland Caribou Southern Mountain Population (Rangifer tarandus caribou) in Canada* (Environment Canada, 2014).

Many of the threats to caribou and caribou habitat are related and may interact. Cumulative effects may not be evident when threats are examined individually. According to the Caribou Recovery Strategy (Environment Canada, 2014), mining is considered to have low impact, small scope, and slight severity when assessed for the northern group of the Southern Mountain population relative to other risks such as forestry and agriculture, because of the site-specific and one time nature of disturbance for mines.

Habitat fragmentation and linear density of roads likely contribute to baseline conditions of reduced caribou habitat suitability in the Project area, as do changes in wildlife population dynamics that may result in increased predation rates on caribou (Hebblewhite et al., 2010; Apps et al. 2013; Steenweg, 2011; Whittington et al., 2011; Williamson-Ehlers, 2012; Williamson-Ehlers et al., 2013). These effects were incorporated into the caribou habitat model and effects assessment for mortality risk by downgrading habitat suitability within 500 m of roads and considering potential predation effects within 1 km within the LSA and by considering linear corridor density and cumulative effects in the RSA.

Project effects consider both the key and moderate interactions defined and identified in **Section 4, Table 4.3-2** (Project Component and Activity Interaction Matrix). In order to conservatively assess interactions of the project with caribou and caribou habitat, both key and moderate interactions were combined and included in modeling and effects assessment. For example, limited recent use of suitable habitat in the mine RSA might be interpreted as a moderate interaction; however, it was included as important habitat effects in the UWR. The interactions are further identified using a ranking table (**Table 5.4.11-3**) to identify potential interactions with different Project phases. Additional analysis included whether the resulting effect can be managed to acceptable levels through standard operating practices, including the application of best management practices (BMPs) or codified practices. Finally, the analysis considered whether the resulting effect may

exceed acceptable levels without implementation of specified mitigation. The table is used to guide specific mitigation and monitoring needed for this VC.

Table 5.4.11-3: Potential Interaction of Project Activities with Caribou

Project Activities	Potential Key and Moderate Interactions
Construction of Mine, Airstrip, Access Roads, Freshwater Supply Pipeline, and Transmission Line	
Clearing and grubbing	2
Open pit preparation	1
General earthworks (moving surface soil)	1
Equipment operation	1
Road upgrading and construction	2
Borrow pit excavation	2
Road and airstrip use	1
Operations of Mine, Airstrip, Access Roads, Freshwater Supply Pipeline, and Transmission Line	
Open pit mining	1
Process plant	1
Transportation system	2
Temporary waste rock stockpiles	2
Tailings storage facility	1
Camp	2
Road use	2
Water collection pond	2
Decommissioning, Closure, and Post-closure Mine, Airstrip, Access Roads, Freshwater Supply Pipeline, and Transmission Line	
Roads	2
Reclamation	2

Note: 0 = No interaction.
 1 = Moderate Interaction occurs; however, based on past experience and professional judgment, the resulting effect can be managed to acceptable levels through standard operating practices and/or through the application of best management or codified practices.
 2 = Key Interaction occurs. The resulting effect may exceed acceptable levels without implementation of mitigation. Further assessment and monitoring is warranted. Several measurable categories of assessment for Project Key and Moderate interaction effects were defined, and the rationale for the selection of each category of assessment is provided in **Table 5.4.11-4**.

Table 5.4.11-4: Categories of Assessment for Caribou

Category of Assessment	Measurable Parameter(s) and Units of Measure	Notes or Rationale for Selection
Habitat Loss and Alteration	<p>Changes in quantity and/or quality of caribou habitat suitability for quantitative to semi-quantitative analysis, i.e., area (ha) and percent change in the availability of moderate or high value/use/suitability habitat from baseline to maximum disturbance for each of the three seasons assessed after Project phases.</p> <p>Area of direct habitat lost or degraded (functional habitat loss) for the Project was assessed relative to the RSA.</p>	<p>Impacts to population abundance and distribution are directly affected by habitat availability and displacement from effective habitat. Vegetation clearing for the Project and sensory disturbance and displacement resulting from Project activities during construction and operations may affect habitat suitability (availability and quality). This includes a ranking of habitat quality for caribou so that the relative quantitative and qualitative loss of moderate to high quality versus lower quality habitat was assessed in relation to regional availability of suitable habitat measured as percentage lost and hectares lost.</p>
Changes in Caribou Population Dynamics	<p>Presence, absence, or change in relative abundance in specific areas or habitats. Caribou subpopulation sizes and distribution will be monitored.</p>	<p>Predation by bears and wolves may be affected by changes in alternate prey abundance/habitat availability resulting in differential mortality of key species. The Project may indirectly alter predator-prey relationships among some species and contribute to cumulative landscape changes. This includes the risk associated with the proposed access road potentially providing increased access for predators and to recreational users (e.g., snow machines) potentially providing increased access for predators (e.g., wolves) and possible changes in moose or other prey densities and distribution.</p>
		<p>Predation risk is also affected by roads and linear features associated with industrial and recreational activities. Encounter rates between wolves and caribou increase with proximity to linear features (Whittington et al., 2011). Wolves are the primary predator of mountain caribou (Edmonds, 1988; Seip, 1992; McNay, 2009; Whittington et al., 2011), but bears, cougars, and wolverines can be locally and/or seasonally important. Bear and wolverine predation are important sources of mortality in some caribou subpopulations (Cichowski and MacLean, 2005; McNay, 2009).</p> <p>This relies on provincial data and potential monitoring data of caribou populations and distribution over the life of the Project, including species, features, and occurrences based on field surveys. Future changes in caribou range occupancy can be monitored with intensive surveys. For caribou, the focus is on relative abundance and distribution of caribou in areas of potential impact and changes to wolf density greater than 3/1,000 km² (Environment Canada, 2014).</p>

BLACKWATER GOLD PROJECT

APPLICATION FOR AN
ENVIRONMENTAL ASSESSMENT CERTIFICATE /
ENVIRONMENTAL IMPACT STATEMENT
ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS



Category of Assessment	Measurable Parameter(s) and Units of Measure	Notes or Rationale for Selection
Mortality Risk	Changes in documented mortality rates, population size, and structure. This includes assessment of possible physical hazards and attractants for wildlife life stages and direct mortality such as hunting and vehicle collisions. Use of road density as a measure of changes to mortality risk and disturbance at the subpopulation scale and within the RSA. A threshold of one caribou killed due to vehicles or illegal harvest (if identified) related to Project activities requires adaptive management and additional mitigation measures.	Assessment of the potential impacts of roads, pits, and other structural features on caribou feeding, migration and movement, refuge, reproductive behaviour and success, and direct mortality. The assessment includes potential effects of direct mortality from vehicles and poaching pressure. This relies on provincial data and potential monitoring caribou mortality related to the Project area. This is a qualitative estimate based on risk of vehicle collisions and poaching risk with a threshold of one animal death triggering adaptive management changes.
Changes in Caribou Movement Patterns – including, assessment of possible sensory disturbance causing avoidance of habitats	Qualitative assessment based on information from habitat mapping and existing knowledge on wildlife movement patterns. Use of intact habitats can be monitored and before/after use documented. Potential avoidance due to sensory disturbance can be monitored. Use of road density as a measure of changes to mortality risk and disturbance.	Changes in movement patterns may impact breeding and survival rates and may increase predation/mortality. Caribou are documented to avoid high traffic volume roads. This relies on monitoring and surveys, as well as provincial survey data (i.e., for caribou). Aspects such as noise, light, odours, and human presence may affect use of habitats close to Project activities. For caribou, changes in movement patterns may impact species access to winter range and breeding and may increase predation/mortality.
Changes in Caribou Health – including assessment of possible chemical hazards and attractants for wildlife	Assessment of the potential impacts of identified contaminants of potential concern on caribou feeding, migration and movement, refuge, reproductive behaviour and success, and direct mortality.	Contaminant loading may affect wildlife health. This is a qualitative measure that relies on reporting of animal health and provincial data. Some human health and ecological risk assessment sampling and risk assessment address part of this concern.

Note: Includes input from consultation with regulators, Aboriginal organizations, affected stakeholders and the public, as well as EA guidelines, other regulatory drivers, policies and/or programs.
ha = hectare; RSA = Regional Study Area.

Evidence suggests that, below certain thresholds of habitat cover, species may decline more rapidly than would be expected from habitat loss alone. When remaining functional habitat is greater than 10% to 30% in a region, species are still affected by habitat loss (Andr n, 1994; Fahrig, 1997; Swift and Hannon, 2010) but are not necessarily at risk of regional extirpation. Depending on the taxa and landscape, residual habitat thresholds ranging from 10% to as high as 60% may be required to avoid rapid population declines (Villard et al., 1999; Swift and Hannon, 2002). However, most threshold evidence supports a minimum 30% residual habitat threshold at a landscape level to avoid rapid declines that may lead to regional extirpation (Swift and Hannon, 2010). For this assessment, precautionary thresholds have been identified for species for which specific thresholds do not exist. A precautionary threshold is defined as the point before a resource would be expected to undergo an unacceptable change, from an ecological, regulatory, or social perspective. This definition allows the Proponent and regulators to enact mitigation measures with sufficient time to prevent the particular resource from reaching or exceeding the true ecological threshold.

The following precautionary thresholds are used in this assessment: 70% residual habitat (30% loss) for species not identified as a conservation concern (e.g., moose, water birds, forest birds); and 80% residual habitat (20% loss) for species of conservation concern (e.g., caribou, grizzly bear, northern myotis). Due to the concern for caribou, any loss of moderate to high value habitat was considered important.

The Caribou Recovery Strategy for the Woodland Caribou Southern Mountain population (Environment Canada, 2014) identifies 65% undisturbed habitat (i.e., 35% loss) as a threshold for cumulative critical habitat loss. This threshold is recognized as a minimum, as it only provides a 60% probability for a local population to be self-sustaining (Environment Canada, 2011).

The ecological threshold approach is limited by species response - habitat generalists respond differently from habitat specialists. The threshold effects of disturbance vary among species and with the amount of habitat fragmentation, vagility of the species of concern, and mortality risk of the intervening habitat matrix in relation to amount of habitat patches retained post-disturbance (Fahrig, 2001; Swift and Hannon, 2010) and degree of patch isolation (Andr n, 1994). Specific to caribou, Sorensen et al. (2008) presented a threshold equation relating cumulative landscape disturbance to population growth rate. However, application of the Sorensen model by Environment Canada (2012), Sleep and Loehle (2010), and Arsenault and Manseau (2011) all concluded a decrease in model fit and/or bias in the model predictions. Therefore, assessment of disturbance thresholds to determine habitat loss effects should be complemented with a monitoring program (within an adaptive management framework) to assess species response to selected variables and to validate the disturbance threshold dynamics.

For the purposes of this assessment, and taking a more conservative approach than the 35% disturbance threshold for caribou, 20% was used as the precautionary disturbance threshold for determining the significance of the Project's effect on undisturbed moderate to high value suitable habitat in the RSA and subpopulation area. With respect to considering cumulative effects, residual loss of moderate to high value suitable caribou habitat is carried forward to the cumulative effects assessment (CEA) to determine loss relative to the Caribou Recovery Strategy objective of less than 35% cumulative habitat disturbance at the subpopulation level.

Effects on caribou are assessed both quantitatively and qualitatively. Environmental effects on habitat availability are assessed quantitatively based on area and percent change in the availability of moderate through high suitability habitat from baseline to maximum disturbance and from baseline to post-closure. Disruption of movement patterns is a qualitative assessment generally based on information from habitat mapping, disturbance patterns, existing knowledge on wildlife movement patterns, and characteristics of Project components. Increase in mortality risk is assessed qualitatively, in the absence of area-specific baseline data and predictive tools, and is based on studies in other jurisdictions and characteristics of Project components. Reduction in animal health is assessed based directly on the results of the Human Health and Terrestrial Ecological Risk Assessment and indirectly on the results of the Water Quality and Liquid Discharges Management Plan (WQLDMP) (**Section 12.2.1.18.4.10**) and Aquatic Resources Management Plan (ARMP) (**Section 12.2.1.18.4.2**).

The next step was to assess each of the interactions with the categories of assessment for the Project phases and caribou to examine which effects may be expected in different areas and times (Table 5.4.11-5).

Table 5.4.11-5: Potential Key and Moderate Interactions with Categories of Assessment for Caribou

Project Activities	Category of Assessment				
	Changes in Habitat Availability	Changes in Caribou Population Dynamics	Changes in Caribou Mortality Risk	Changes in Caribou Movement Patterns	Changes in Caribou Health
Construction of Mine, Airstrip, Access Roads, Freshwater Supply Pipeline, and Transmission Line					
Clearing and grubbing	2	2	0	1	0
Open pit preparation	1	1	1	2	0
General earthworks (moving surface soil)	1	0	0	1	0
Equipment operation	1	1	1	1	0
Road upgrading and construction	2	1	0	1	0
Borrow pit excavation	2	2	0	1	0
Road and airstrip use	1	1	2	1	0
Operations of Mine, Airstrip, Access Roads, Freshwater Supply Pipeline, and Transmission Line					
Open pit mining	1	1	1	1	0
Process plant	1	1	1	1	0
Transportation system	2	1	2	2	0
Temporary waste rock stockpiles	2	1	0	1	0
Tailings storage facility	1	1	1	1	0
Camp	2	1	0	1	0
Road use	2	1	2	1	0
Water collection pond	2	1	1	1	0
Decommissioning, Closure, and Post-closure Mine, Airstrip, Access Roads, Freshwater Supply Pipeline, and Transmission Line					
Roads	2	1	1	1	0
Reclamation	2	2	0	2	0

Note: 0 = No interaction.
 1 = Moderate Interaction occurs; however, based on past experience and professional judgment, the resulting effect can be managed to acceptable levels through standard operating practices and/or through the application of best management or codified practices.
 2 = Key Interaction occurs. The resulting effect may exceed acceptable levels without implementation of mitigation. Further assessment and monitoring is warranted.

Potential Key and Moderate interactions are linked to the temporal scale of the Project phases and vary in the time needed to return to baseline conditions (Table 5.4.11-6). For instance, sensory disturbances tend to be very short-lived and transient, with effects often related to frequency of

disturbance and duration. Conversely, habitat loss due to Project construction may require a considerable amount of time to recover to baseline conditions.

Anticipated Project effects include direct habitat loss (e.g., cleared vegetation, changes to habitat quantity and quality) and some potential degradation (**Figure 5.4.11-8**). The construction of the mine site, access roads, transmission line, freshwater supply pipeline, and airstrip will require the removal of vegetation. A small amount of this vegetation will be lost permanently (greater than 100 years), while the majority of other areas will be reclaimed progressively or during closure.

In addition to direct habitat loss, activities on the mine site, airstrip, and access roads may reduce functional use of habitat. Road use may result in direct mortality from vehicle collisions and displacement from suitable habitat from sensory disturbance (e.g., noise and visual disturbance from mine-related activity). Chemical hazards and attractants have a small potential to affect caribou that frequent the mine area, airstrip, transmission line, or access roads.

Table 5.4.11-6: Temporal Boundaries

Category of Assessment	Temporal Boundary
Habitat Loss and Alteration	Construction through to late seral structures and vegetation compositions (50 to 80 years after reclamation for lichen re-establishment)
Mortality Risk	Construction and operations
Change in Caribou Population Dynamics	All phases after clearing and during construction
Change in Caribou Movement Patterns	Construction and operations
Change in Caribou Health	All phases during construction and operations

Table 5.4.11-7: Overview of Potential Project Effects on Caribou

Category of Assessment	Description	Project Phases	Project Components
Habitat Loss and Alteration	Areas that will be cleared of vegetation for Project infrastructure (e.g., facility direct footprint, road surface and cut/fill, borrow areas, etc.) result in temporary to long-term habitat loss. Loss and degradation of habitat will occur during construction phase and adverse effects will be evident through to closure and post-closure phases.	Construction, operations, closure and decommissioning, post-closure	Mine site, access roads, transmission line, freshwater supply pipeline, and airstrip
Mortality Risk	Direct mortality from physical exposure to traffic or attractants; disrupted movements and displacement from areas used for reproduction or feeding.	Construction, operations, closure and decommissioning, post-closure	Mine site, access roads, transmission line, freshwater supply pipeline, and airstrip
Changes in Caribou Population Dynamics	Changes in the abundance of predators or prey result in mortality and displacement from areas used for reproduction or feeding.	Construction, operations, closure and decommissioning, post-closure	Mine site, access roads, transmission line, freshwater supply pipeline, and airstrip

Three of the five potential categories of assessment—habitat loss and alteration, change in caribou mortality risk, and caribou population dynamics—are applicable to the Project and therefore carried through the effects assessment (**Table 5.4.11-4**). The other two potential effects—changes in wildlife health and movement patterns—will not be considered further in the assessment. The rationale for this decision is that caribou is a wide-ranging species, with a low density of caribou using the Project area, and the mitigation measures included in the Wildlife Management Plan (WLMP) (**Section 12.2.1.18.4.5**), Noise and Vibration Mitigation Measures (**Section 5.2.2.3**) and Air Quality and Emissions Management Plan (AQEMP) (**Section 12.2.1.18.4.9**) are predicted to limit potential effects on these categories to negligible levels. The noise and vibration effects assessment states that no meaningful changes to ambient noise levels can be expected beyond the Project boundary; therefore, residual effects are negligible even though caribou occur intermittently in the LSA. Blasting and aircraft noise exceed ambient noise levels; however, they likely will have a minimal impact on equivalent sound pressure levels due to their very short duration. The small zone of influence relative to the population range and RSA suggests negligible effect, although at a local scale (LSA) they may be more significant, resulting in temporary local displacement and disturbance of caribou if present in the LSA at the time of disturbance. Klein (1980) states that local resident caribou should more readily habituate to human-associated disturbances than seasonal migratory caribou. Harrington and Veitch (1992) observed no significant relationship between calf survival and exposure to low-level flying during pre-calving period, late post-calving, or during fall. Lawler et al. (2005) recorded short-term reactions of caribou to jet overflights as mild.

In order to consider potential effects, habitat suitability value was reduced within 500 m of the mine and roads in high value suitable habitat. Consequently, changes in wildlife movement patterns due to noise disturbance are not considered further but are included in habitat alteration considerations through buffering and downgrading habitat suitability near infrastructure.

Wildlife health is not carried forward due to the conclusions of the Atmospheric Effects Assessment and the Surface Water Quality Effects Assessment. The Atmospheric Effects Assessment determined that overall, potential effects of the Project on air quality are not significant because adverse residual effects are not predicted to result from the construction, operations, or decommissioning of the Project. The Surface Water Quality Effects Assessment expects that residual effects relate to parameter-specific potential exceedances of water quality guidelines that are a consequence of existing background concentrations above guidelines and therefore are not considered to be a result of Project-related effects and are not expected to increase or create health effects to caribou different from the baseline condition.

5.4.11.3.6 Assessment Approach of Measuring Potential Effects

A quantitative habitat approach for habitat was used to assess the potential Project effects on caribou. To capture the most valuable habitats for caribou, rating tables were developed to model the moderate to high value habitats (rating values 1–3) in the Project area during the winter and growing periods (i.e., spring, summer, fall). Potential areas affected by Project component footprints (**Appendix 5.4.11B**) were calculated. Terrestrial Ecosystem Mapping (TEM) or Predictive Ecosystem Mapping (PEM) formed the basis for habitat polygons rated in the LSA and

portions of the RSA. Habitat data were not available for the caribou subpopulation areas; however, road density and cumulative effects from MPB infestation, forestry, and wildfires on an area basis for the subpopulations were assessed as a qualitative measure of mortality risk, changes to wildlife population dynamics, and habitat loss and alteration. Effects from MPB infestation were considered as future habitat loss and alteration, and overlap with the areas currently burning in the 2014 wildfires near the proposed project.

5.4.11.3.6.1 Habitat Suitability Model Assumptions

Habitat suitability modeling is based on assumptions related to TEM and PEM habitat interpretations, professional judgement and experience related to caribou and caribou habitat, literature and traditional knowledge. Assumptions include the quantitative rating of TEM and PEM units for value to caribou during different life history stages and seasons and are based on similar models used and tested throughout BC and assessed over time through population surveys and collared animals. Specific assumptions related to habitat quality are described in each sub-model. Habitat suitability value is assumed to reflect the current value of habitat and not the future value.

Assumptions related to mortality, disturbance, displacement, predation and health are described in the effects sections related to these categories of assessment. Habitat ratings were interpreted to represent potential reductions in habitat quality and effectiveness related to mine infrastructure. Although recent data did not indicate frequent use or use by many caribou in the RSA, models assumed that all suitable habitat could be used and that habitat was included in calculations of habitat impacted by the Project.

5.4.11.3.6.2 Caribou Rating Assumptions for Habitat Suitability Models

Caribou habitat suitability ratings are found in **Appendix 5.4.11B** and include:

- Immature forests (age classes 1 to 4, less than 80 years; seral stages 1 to 5) have minimal feeding or security habitat values for all seasons (suitability 4–5);
- Mature/old-growth ESSF, MS, and SBPS forests with abundant terrestrial and arboreal lichens (age classes 8 and 9; structural stages 6 and 7), have high values (suitability = 1) for feeding and moderate to low values (suitability greater than 3) for security;
- Mature/old-growth ESSF forests have the highest late winter feeding values (suitability = 1) for arboreal lichens, particularly on wetter sites. Windswept alpine tundra ridges and gentle to moderate slopes with access to terrestrial lichens have high feeding and security values (suitability 1–2) for winter, and moderate to low feeding value (suitability 3–4) for the growing season;
- Mid to upper slopes of the ESSF West Chilcotin Very Dry Very Cold variant (ESSFvx1) with high terrestrial lichen cover and lichen-bearing trees (classes 3 to 5 *Bryoria*, *Alectoria*) have high feeding value (suitability = 1) for winter. Moist forest habitats

(moss/seepage forest, wetland/wetland forest, and horsetail ecosystem units) have moderately high (suitability = 1-2) feeding values in spring;

- Steep, rugged, exposed terrain above the treeline (e.g., subalpine rock outcrops with krummholz) has high values (suitability = 1) for calving habitat;
- Fescue – Lichen meadows (Habitat unit: TF – Timber oatgrass – Altai fescue cold dry meadows) provide moderate value (suitability = 3) feeding habitat in the growing season, particularly in fall, but are rarely used in late winter (suitability = 5) due to deep snow;
- Lakes and wetlands in the ESSF and Boreal Altai Fescue Alpine (BAFA) BGC zones were rated as high value (suitability 1) for all life stages;
- Specific ecosystems that are rated high (e.g. pine-lichen and wetland ecosystem units LC and LF) are identified in **Appendix 5.4.11B**; and
- Habitat suitability ratings and models represent the current habitat value for caribou and may change with MPB and fire in the near future and these changes are considered under cumulative effects.

5.4.11.3.6.3 Ratings Adjustments

Habitat suitability maps incorporate landscape heterogeneity and connectivity, including habitats adjacent to anthropogenic disturbance regimes (e.g., roads, settlements), and interspersions of different structural stages within the landscape. Adjustments can increase or decrease suitability value by a single class. Habitats within 500 m of high activity roads and infrastructure are considered to have greater potential displacement and mortality risk (Environment Canada, 2014). Polygons identified in the field with either having high arboreal or terrestrial forage lichen values were increased in their ratings either one or two classes depending on lichen abundance. Interspersions of structural stages and habitat connectivity were not directly modelled, but assessed through changes in relative habitat suitability at the different study area scales.

5.4.11.3.6.4 Habitat Suitability Model Development

As part of the environmental assessment, caribou habitat loss originating from the Project was assessed using habitat suitability modelling.

Suitable caribou habitat exists within the LSA. Arboreal and terrestrial lichen surveys were done to document important habitat within the LSA and in adjacent areas of the RSA and used to validate habitat suitability ratings developed for caribou. The lichen surveys were conducted within the mine LSA and RSA to determine which BGC zones and variants should be rated as high value as a potential source of caribou forage within the Project area. The BGC zones within the Project area that were identified as having high forage value based on these lichen surveys were then increased in value in the ratings table.

Three seasons of habitat use—spring, summer/fall (growing), and winter—were evaluated for habitat suitability mapping. The life requisites rated included Feeding, Security, and Thermal habitats for the specified season. The ratings were primarily driven by the feeding habitat

suitability, and security and thermal values were used to adjust this value in areas identified as low feeding value but high for security or thermal value. For caribou, the habitat value was downgraded within 500 m of disturbance and roads in the mine LSA. Due to the availability of information about specific life requisites for caribou, a six-class rating scheme habitat model was applied (Resources Information Standards Committee (RISC), 1999).

5.4.11.3.6.5 Caribou Winter Habitat Suitability Model

Winter habitats are the most limiting for caribou, in terms of both abundance and vulnerability to predation. In early winter (December to March), both immature and mature stands of dry, terrestrial lichen are used extensively. By late winter and early spring (mid-March to April) caribou commence using more moist forested sites in addition to the dry lichen sites (Cichowski, 1993). For northern caribou, structural stage 7 old-growth forest, with complex structure, well developed arboreal lichen, snow interception, and higher thermal cover values, usually has the highest winter suitability ratings. Mature forest of structural stage 6, with well-developed arboreal lichen, but less forest openings and terrestrial lichens, also provides useful habitat, particularly the older and more diverse stands. Northern caribou may forage in structural stage 5 mature forests with less structural diversity than a stage 6, but in the case of pine stands that are old enough to support lichen development, forage (terrestrial lichens) may be abundant in some areas and ecosystems with lower structural stages (Cichowski et al., 2004).

Data suggest that, during winter, small patches of pine-lichen woodland, with as little as 19% lichen cover, are of value during caribou's wide-ranging movements (Johnson et al., 2004). When foraging in winter, caribou will dig through the snow, creating a crater up to 2 m deep in search of terrestrial lichens. Caribou also dig through the snow at the base of spruce trees for horsetails and at the base of pine trees for terrestrial lichens (Johnson et al., 2004).

Caribou use security habitat to avoid contact with predators. Rugged, exposed alpine/subalpine terrain provides caribou with optimum security habitat where they can distance themselves from other prey species and best detect and avoid predators (Poole et al., 2000). Predation risk is greatest for caribou travelling between habitat patches, is lowest in alpine habitat, and has no apparent influence on intra-patch movements (Johnson et al., 2004). When caribou use forested habitats they compromise security for foraging needs (Seip and Cichowski, 1996; Bergerud, 1996). Unlike other cervids, such as moose, which prefer to hide in dense forest cover, caribou use large frozen lakes and wetlands adjacent to forest stands as escape terrain because caribou are better adapted to travel through deep snow than are their predators (Calef, 1981; Higgelke and MacLeod, 2000). In both forested and non-forested habitats, caribou need large tracts of land through which they can disperse to reduce predation levels (Environment Canada, 2012; Mountain Caribou Technical Advisory Committee, 2002). Alpine and subalpine habitats, as well as nearby horsetail wetlands and lichen-pine forests, tend to provide the most suitable habitat.

5.4.11.3.6.6 Caribou Spring Habitat Suitability Model

Spring habitat was modelled for living which includes feeding but also security from predation during calving. At the time of spring parturition (late May to early June), caribou cows and calves

are particularly vulnerable to predation. During this season, caribou require isolation and concealment from predators. Pregnant caribou cows will disperse throughout rugged subalpine/alpine terrain or forested habitats to calve and rear young. Subalpine and alpine habitats with abundant lichen and small lakes/wetlands near these areas tend to have the highest spring suitability rating.

5.4.11.3.6.7 Caribou Summer/Fall (Growing Season) Habitat Suitability Model

Caribou have a much more varied diet in summer and fall when, besides lichens, they will feed on a variety of graminoids, forbs, shrubs, mosses, and fungi in forests, wetlands, subalpine parkland, and alpine tundra, making growing season models less restrictive (Seip and Cichowski, 1996; Bergerud, 1996). Subalpine and alpine habitats with abundant lichen tend to have the highest summer/fall suitability rating.

5.4.11.3.7 Results for Assessment of Potential Project Effects on Habitat

5.4.11.3.7.1 Model Results for Quantification of Potential Project Effects on Habitat

The potential overlap of Project component footprints on moderate to high suitable caribou habitats are tabulated in **Table 5.4.11-8** (spring), **Table 5.4.11-9** (summer/fall), and **Table 5.4.11-10** (winter). The areas represent the maximum potential habitat affected and do not account for existing disturbance or mitigation measures. Habitat suitability is illustrated on **Figure 5.4.11-3** (spring suitability), **Figure 5.4.11-4** (summer/fall suitability), and **Figure 5.4.11-5** (winter suitability).

5.4.11.3.7.2 Habitat Loss and Alteration

The habitat loss and alteration category of effects is a method of accounting for areas of vegetation removal and/or ground disturbance due to placement of infrastructure and edge effects. To simplify the effects assessment, all lost areas are combined regardless of how long they are lost (even though the Project area will be reclaimed, except for some small features) to represent a worst-case scenario. Clearing of forest within the study areas will result in a decrease of available potential habitat within the Project area. Effects of direct habitat loss are assessed relative to the amount of similar habitat available within the RSA and related to the threshold of magnitude set to determine significance.

Although model predictions are that levels outside the Project fence line will be 45 dBA or lower, research suggests that noise from Project construction, operations, and camp may displace caribou from using habitats up to 1 km of the mine site during operations on a relatively continuous basis; therefore, noise is considered an impact and included in the effects assessment. The proposed access road and airstrip may also temporarily displace caribou from using habitats close to the road or airstrip during periods of frequent traffic. Effective habitat loss from potential degradation of caribou habitat considers habitat alteration through displacement from sensory disturbance and increased predation risk. Based on the predictions of noise modeling, a distance of 500 m from the edge of infrastructure is used to estimate the effective loss of caribou habitat in the mine LSA. Caribou cross the existing road and similar forestry access roads in other areas;

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therefore, the road is not considered a barrier to movement. Historical telemetry data and observations for similar roads suggest that caribou cross roads similar to the FSR and mine access roads in the Project (Dyer et al., 2001; James and Stuart-Smith, 2000). Effects of habitat loss can potentially occur from the start of Project construction to post-closure; however, other effects only occur through to closure. This is based on the various types of habitat alteration, time needed for re-growth of lichen habitats, and the potential effects on caribou, as the Project components (e.g., road, airstrip, and transmission line) effects within the caribou subpopulation range is limited.

Table 5.4.11-8: Potential Caribou Spring Suitability Habitat Area Affected Within Footprints, LSAs, and RSA

	Project Component	Caribou Moderate Habitat (3) Area (ha)	Total Area (ha)	Moderate Habitat % of Total Area	% of RSA Habitat by Footprint Component	Caribou Moderately High Habitat (2) Area (ha)	Total Area (ha)	Moderately High Habitat % of Total Area	% of RSA Habitat by Footprint Component	Caribou High Habitat Area (1) (ha)	Total Area (ha)	High Habitat % of Total Area	% of RSA Habitat by Footprint Component
Footprint or Corridor	Access Road	4	95	4	<1	6	95	6	<1	0	95	0	0
	Airstrip	5	50	10	<1	2	50	4	<1	0	50	0	0
	Kluskus FSR	6	253	6	<1	1	253	1	<1	0	253	0	0
	Mine Site	1,883	4,430	43	3	1,001	4,430	23	3	407	4,430	9	33
	Freshwater Supply Pipeline	6	132	4	<1	4	132	3	<1	0	132	0	0
	Transmission Line - Main	86	1806	13	<1	24	1806	4	<1	3	1806	1	<1
	Transmission Line - Mills Ranch	1	202	0	<1	9	202	5	<1	0	202	0	0
	Total	1,990	5,658	35	3	1,046	5,658	18	3	411	5,658	7	33
LSA	Access Road	48	363	15	<1	32	363	9	<1	30	363	1	2
	Airstrip	52	465	3	<1	52	465	11	<1	0	465	0	1
	Kluskus FSR	215	6,574	8	<1	138	6,574	5	<1	15	6,574	1	1
	Mine Site	2,655	6,123	44	4	1,445	6,123	24	4	486	6,123	8	39
	Freshwater Supply Pipeline	49	731	17	<1	61	731	8	<1	5	731	1	<1
	Transmission Line - Main	394	8,068		<1	148	8,068	5	<1	17	8,068	1	1
	Transmission Line - Mills Ranch	18	924		<1	40	924	4	<1	4	924	0	<1
	Total	3,432	14,061	24	5	1,915	14,061	14	6	530	14,061	4	42
RSA		74,616	258,408	29	-	32,849	258,408	13	-	1,252	258,408	0	-
Area	Footprint % RSA	2	-	-	-	2	-	-	-	2	-	-	-
	Footprint % LSA	40	-	-	-	40	-	-	-	40	-	-	-
Habitat	Footprint % RSA Habitat	3	-	-	-	3	-	-	-	33	-	-	-
	Footprint % LSA Habitat	58	-	-	-	55	-	-	-	78	-	-	-

Note: FSR = Forest Service Road; ha = hectare; LSA = Local Study Area; RSA = Regional Study Area; % = percentage

Table 5.4.11-9: Potential Caribou Summer/Fall Suitability Habitat Area Affected Within Footprints, LSAs, and RSA

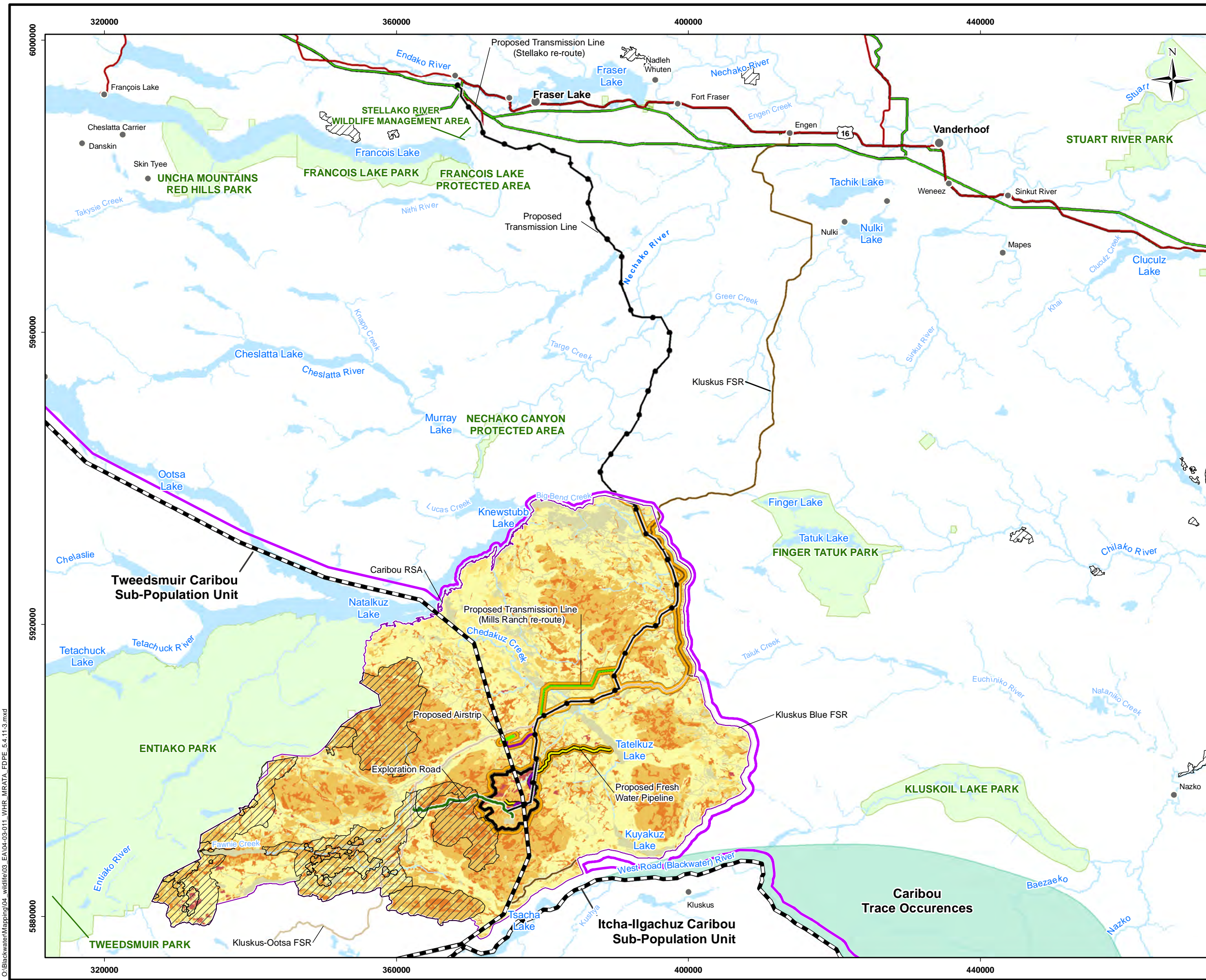
	Project Component	Caribou Moderate Habitat (3) Area (ha)	Total Area (ha)	Moderate Habitat % of Total Area	% of RSA Habitat by Footprint Component	Caribou Moderately High Habitat (2) Area (ha)	Total Area (ha)	Moderately High Habitat % of Total Area	% of RSA Habitat by Footprint Component	Caribou High Habitat Area (1) (ha)	Total Area (ha)	High Habitat % of Total Area	% of RSA Habitat by Footprint Component
Foot print or Corridor	Access Road	24	95	25	<1	6	95	6	<1	0	95	0	0
	Airstrip	7	50	14	<1	2	50	4	<1	0	50	0	0
	Kluskus FSR	6	253	6	<1	1	253	1	<1	0	253	0	0
	Mine Site	2,289	4,430	52	3	988	4,430	22	3	131	4,430	3	77
	Freshwater Supply Pipeline	14	132	11	<1	3	132	2	<1	0	132	0	0
	Transmission Line - Main	177	650	27	<1	22	650	3	<1	1	650	0	<1
	Transmission Line - Mills Ranch	106	202	52	<1	9	202	5	<1	0	202	0	0
	Total	2,622	5,658	46	3	1,030	5,658	18	3	132	5,658	2	77
LSA	Access Road	128	363	35	<1	32	363	9	<1	1	363	0	<1
	Airstrip	134	465	29	<1	52	465	11	<1	0	465	0	0
	Kluskus FSR	470	6,574	19	1	136	6,574	5	<1	1	6,574	0	<1
	Mine Site	3,174	6,123	52	4	1,472	6,123	24	4	158	6,123	3	92
	Freshwater Supply Pipeline	204	731	28	<1	59	731	8	<1	0	731	0	0
	Transmission Line - Main	865	8,068	30	1	147	8,068	5	<1	1	8,068	0	1
	Transmission Line - Mills Ranch	465	924	50	1	40	924	4	<1	0	924	0	0
	Total	5,440	14,061	39	7	1,937	14,061	14	6	162	14,061	1	95
RSA		83,252	258,408	32	-	32,966	258,408	13	-	171	258,408	0	-
Area	Footprint % RSA	2	-	-	-	2	-	-	-	2	-	-	-
	Footprint % LSA	40	-	-	-	40	-	-	-	40	-	-	-
Habitat	Footprint % RSA Habitat	3	-	-	-	3	-	-	-	77	-	-	-
	Footprint % LSA Habitat	48	-	-	-	53	-	-	-	82	-	-	-

Note: FSR = Forest Service Road; ha = hectare; LSA = Local Study Area; RSA = Regional Study Area; % = percentage

Table 5.4.11-10: Potential Caribou Winter Suitability Habitat Area Affected Within Footprints, LSAs, and RSA

	Project Component	Caribou Moderate Habitat Area (3) (ha)	Total Area (ha)	Moderate Habitat % of Total Area	% of RSA Habitat by Footprint Component	Caribou Moderately High Habitat (2) Area (ha)	Total Area (ha)	Moderately High Habitat % of Total Area	% of RSA Habitat by Footprint Component	Caribou High Habitat (1) Area (ha)	Total Area (ha)	High Habitat % of Total Area	% of RSA Habitat by Footprint Component
Footprint or Corridor	Access Road	7	95	7	<1	6	95	6	<1	0	95	0	9
	Airstrip	5	50	10	<1	2	50	4	<1	0	50	0	0
	Kluskus FSR	21	253	21	<1	7	253	7	<1	0	253	0	0
	Mine Site	2,087	4,430	47	3	1,001	4,430	23	2	407	4,430	9	31
	Freshwater Supply Pipeline	6	132	4	<1	4	132	3	<1	0	132	0	0
	Transmission Line - Main	117	650	18	<1	24	650	4	<1	4	650	1	<1
	Transmission Line - Mills Ranch	12	202	6	<1	10	202	5	<1	3	202	1	<1
	Total	2,254	5,658	40	3	1,054	5,658	19	2	415	5,658	7	31
LSA	Access Road	61	363	17	<1	32	363	9	<1	3	363	1	<1
	Airstrip	57	465	12	<1	52	465	11	<1	0	465	0	0
	Kluskus FSR	291	6,574	11	<1	202	6,574	8	<1	37	6,574	1	3
	Mine Site	2,876	6,123	47	4	1,443	6,123	24	3	486	6,123	8	37
	Freshwater Supply Pipeline	81	731	11	<1	61	731	8	<1	5	731	1	<1
	Transmission Line - Main	557	8,068	19	<1	163	8,068	6	<1	27	8,068	1	2
	Transmission Line - Mills Ranch	78	924	8	<1	41	924	4	<1	19	924	2	1
	Total	4,001	14,061	28	6	1,994	14,061	14	5	577	14,061	4	44
RSA		71,181	258,408	28	-	42,197	258,408	16	-	1,323	258,408	1	-
Area	Footprint % RSA	2	-	-	-	2	-	-	-	2	-	-	-
	Footprint % LSA	40	-	-	-	40	-	-	-	40	-	-	-
Habitat	Footprint % RSA Habitat	3	-	-	-	2	-	-	-	31	-	-	-
	Footprint % LSA Habitat	56	-	-	-	53	-	-	-	72	-	-	-

Note: FSR = Forest Service Road; ha = hectare; LSA = Local Study Area; RSA = Regional Study Area; % = percentage



Legend

- Populated Place
- Highway
- Existing Transmission Line
- Exploration Road
- Proposed Transmission Line
- Proposed Transmission Line (Mills Ranch re-route)
- Proposed Transmission Line (Stellako re-route)
- Proposed Fresh Water Pipeline
- Proposed Mine Site Access Road
- Proposed Airstrip
- Proposed Mine Site
- Stream (>= 4th Order)
- Waterbody (>= 100 Ha)
- Parks and Protected Areas

Caribou

- Caribou Local Study Area
- Caribou Regional Study Area
- Area Used for Habitat Loss and Alteration Analysis

Caribou Sub-Population Unit (BC Gov)

- Caribou Sub-Population Unit
- Trace Occurrences
- Ungulate Winter Range

Wildlife Habitat Rating

- 1 - High
- 2 - Moderately High
- 3 - Moderate
- 4 - Low
- 5 - Very Low
- 6 - Nil

Scale: 1:500,000
0 5 10 20 Kilometres

Reference
BC Government GeoBC Data Distribution

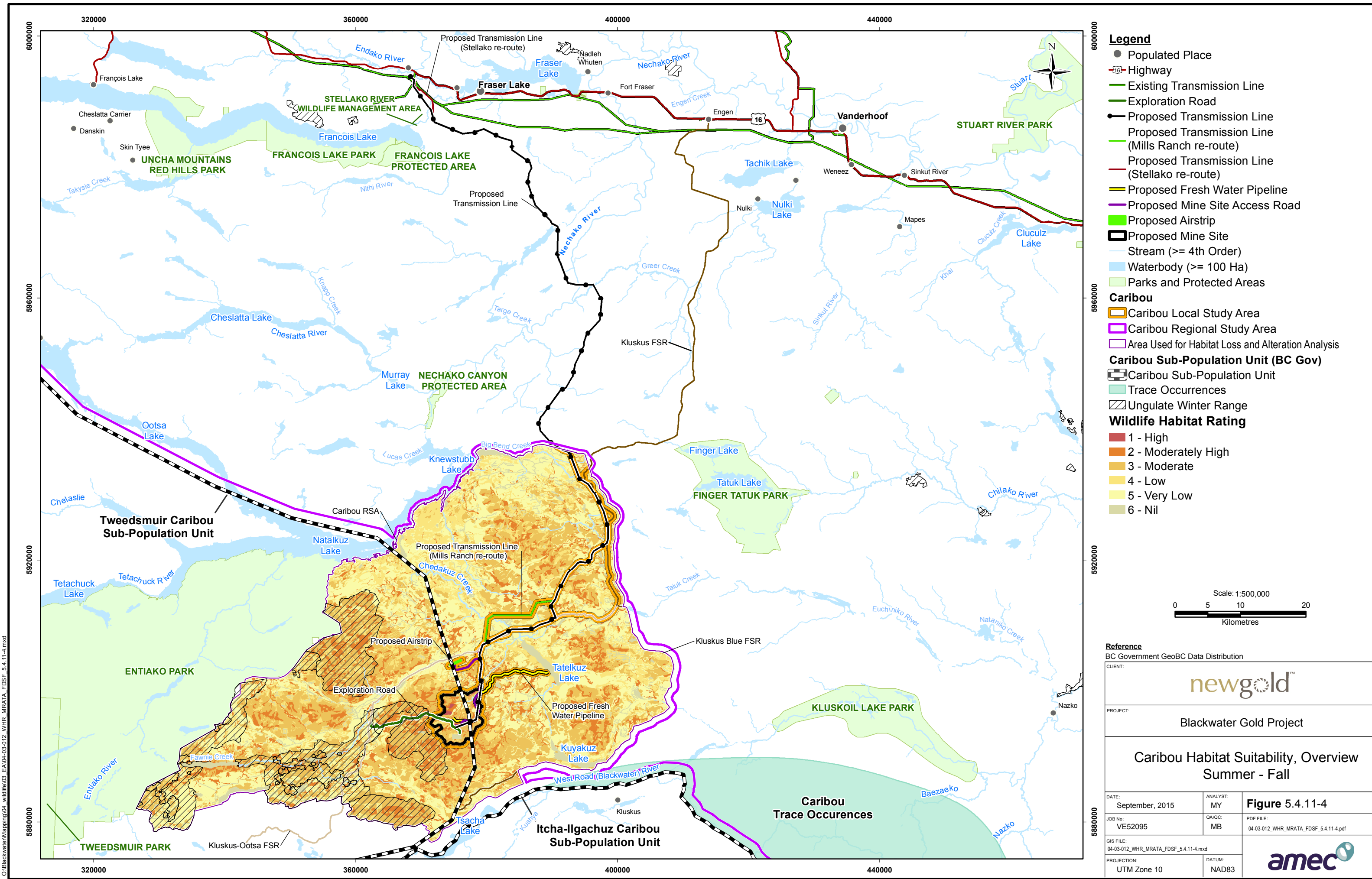
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PROJECT: **Blackwater Gold Project**

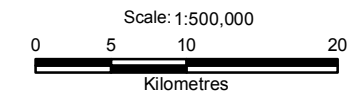
Caribou Habitat Suitability, Overview Spring

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PROJECTION: UTM Zone 10	DATUM: NAD83	

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- Legend**
- Populated Place
 - Highway
 - Existing Transmission Line
 - Exploration Road
 - Proposed Transmission Line
 - Proposed Transmission Line (Mills Ranch re-route)
 - Proposed Transmission Line (Stellako re-route)
 - Proposed Fresh Water Pipeline
 - Proposed Mine Site Access Road
 - Proposed Airstrip
 - Proposed Mine Site
 - Stream (>= 4th Order)
 - Waterbody (>= 100 Ha)
 - Parks and Protected Areas
- Caribou**
- Caribou Local Study Area
 - Caribou Regional Study Area
 - Area Used for Habitat Loss and Alteration Analysis
- Caribou Sub-Population Unit (BC Gov)**
- Caribou Sub-Population Unit
 - Trace Occurrences
 - Ungulate Winter Range
- Wildlife Habitat Rating**
- 1 - High
 - 2 - Moderately High
 - 3 - Moderate
 - 4 - Low
 - 5 - Very Low
 - 6 - Nil



Reference
BC Government GeoBC Data Distribution

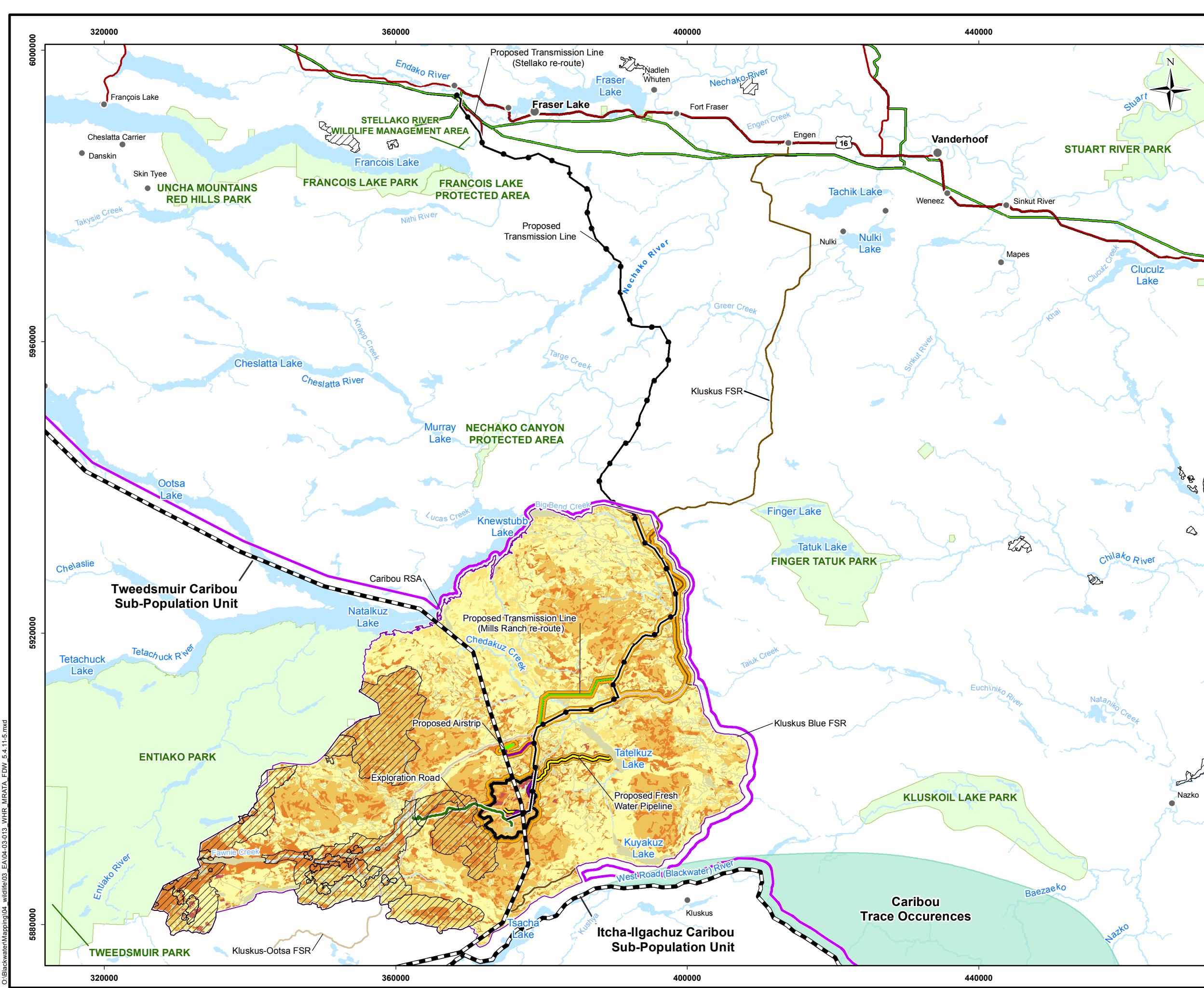
CLIENT: **newgold™**

PROJECT: **Blackwater Gold Project**

Caribou Habitat Suitability, Overview Summer - Fall

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PROJECTION: UTM Zone 10	DATUM: NAD83	

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Legend

- Populated Place
- Highway
- Existing Transmission Line
- Exploration Road
- Proposed Transmission Line
- Proposed Transmission Line (Mills Ranch re-route)
- Proposed Transmission Line (Stellako re-route)
- Proposed Fresh Water Pipeline
- Proposed Mine Site Access Road
- Proposed Airstrip
- Proposed Mine Site
- Stream (>= 4th Order)
- Waterbody (>= 100 Ha)
- Parks and Protected Areas

Caribou

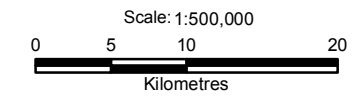
- Caribou Local Study Area
- Caribou Regional Study Area
- Area Used for Habitat Loss and Alteration Analysis

Caribou Sub-Population Unit (BC Gov)

- Caribou Sub-Population Unit
- Trace Occurrences
- Ungulate Winter Range

Wildlife Habitat Rating

- 1 - High
- 2 - Moderately High
- 3 - Moderate
- 4 - Low
- 5 - Very Low
- 6 - Nil



Reference
BC Government GeoBC Data Distribution

CLIENT: **newgold™**

PROJECT: **Blackwater Gold Project**

Caribou Habitat Suitability, Overview Winter

DATE: September, 2015	ANALYST: MY	Figure 5.4.11-5
JOB No: VE52095	QA/QC: MB	PDF FILE: 04-03-013_WHR_MRATA_FD_W_5.4.11-5.pdf
GIS FILE: 04-03-013_WHR_MRATA_FD_W_5.4.11-5.mxd		amec
PROJECTION: UTM Zone 10	DATUM: NAD83	

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Caribou habitat was identified and mapped within the LSA and RSA using a six-class wildlife habitat suitability ranking system for spring, summer/fall, and winter habitats based on TEM and PEM (RISC, 1999; **Appendix 5.4.11B**). High quality caribou habitat consists of high value feeding in spring, summer/fall, and winter and of adjacency to security habitat within the caribou subpopulation ranges. These habitats are characterized by high elevation forest close to openings rich in food species and high elevation wind swept and parkland areas, particularly those with well-developed arboreal or terrestrial lichen cover.

Of the caribou spring habitat in the RSA, 29% (74,616 ha) is rated as moderate value, 13% (32,849 ha) is rated as moderately high value, and less than 1% (1,252 ha) is rated as high value (**Table 5.4.11-8**). Of the suitable spring RSA habitat, Project components overlap approximately 3% of moderate, 3% of moderately high, and 33% of high value habitat (**Figure 5.4.11-3**). Most potential effects on caribou spring habitat are anticipated to be associated with clearing of forests with arboreal and terrestrial lichens at the mine site. The transmission line footprint (including re-route options) is predicted to overlay a less than 1% of moderate, moderately high, and high value habitat.

Of the caribou summer/fall habitat in the RSA, 32% (83,252 ha) is rated as moderate value, 13% (32,966 ha) is rated as moderately high value, and less than 1% (171 ha) is rated as high value (**Table 5.4.11-9**). Of the suitable summer RSA habitat, Project components overlap approximately 3% of moderate, 3% of moderately high, and 77% of high value habitat (**Figure 5.4.11-4**). Potential effects on caribou summer habitat are primarily associated with clearing of moderate to high rated habitat in forests at the mine site. The transmission line footprint (including re-route options) is predicted to overlay less than 1% of moderate, moderately high, and high value habitat.

Of the caribou winter habitat in the RSA, 28% is rated as moderate value habitat, 16% is rated as moderately high value, and 1% is rated as high value (**Table 5.4.11-10**). Of the suitable winter RSA habitat available, Project components overlap approximately 3% of moderate, 2% of moderately high, and 31% of high value habitat (**Figure 5.4.11-5**). The transmission line footprint (including re-route options) is predicted to overlay less than 1% of moderate, moderately high, and high value habitat as it is mainly outside the current herd range.

The total maximum extent of the Project footprint and buffers (within clearing limits including all area nil to low-suitable rated caribou habitat) categorized as lost is 5,658 ha. The clearing limits equal maximum area potentially lost and include previously disturbed area. As a conservative estimate, this does not include restored area after reclamation. Use of the existing Kluskus FSR and Stellako transmission line option would have negligible additional impact as moderate to high value baseline suitable caribou habitat is not affected by the Project.

Within the RSA, the overall effect of the Project on caribou will likely be a maximum potential reduction of 3,448 ha (3%) of moderate to high value available suitable spring habitat; 3,785 ha (5%) of moderate to high value available suitable summer/fall habitat; and 3,723 ha (3%) of moderate to high value available suitable winter habitat. Wildlife habitat alteration and loss are carried forward to CEA.

Critical habitat is spatially defined by the Caribou Recovery Strategy (Environment Canada, 2014) as the Ungulate Winter Range and cumulative disturbance level of Type I Matrix Habitat within the subpopulation range (65% undisturbed). However, high and moderate value caribou habitat outside of critical habitat may be directly affected by the Project footprint or be functionally affected through avoidance and/or barrier effects from the Project and associated infrastructure, including access and traffic volumes. Suitability modeling and effects assessment are used to evaluate potential effects on these habitats.

5.4.11.3.7.3 Changes in Caribou Population Dynamics

A risk to caribou in the LSA is related to indirect effects of changes in the predator-prey balance, such as changes in moose densities and availability and the subsequent changes in wolf densities. Increased mortality risk is assigned to areas up to 500 m away from any roads associated with the Project (Environment Canada, 2014). This risk is associated with the proposed access road, potentially providing increased access for predators (e.g., wolves) and to recreational users (snow machines), which may lead to declines in moose or other prey. Other indirect effects relate to a potential for increased early seral vegetation associated with clearing that may increase the amount of alternate prey species, specifically moose, elk, or deer, which results in increased wolf numbers and increased predation rates on caribou. Effects on caribou can potentially occur from the start of Project construction to post-closure. The primary access road, the Kluskus FSR, is an existing road with a history of access and traffic, and incremental access effects are limited to the mine access road. Based on the Caribou Recovery Strategy (Environment Canada, 2014), the threshold for significance related to changes in caribou population dynamics is a regional wolf population exceeding 3 wolves/1,000 km². Based on observed calf mortality rates during fall 2013 surveys, wolf densities are likely greater than this threshold in the Tweedsmuir-Entiako subpopulation area (Hebert, 2013, pers. comm.).

Predation risk is also affected by roads and linear features associated with industrial and recreational activities. Encounter rates between wolves and caribou increase with proximity to linear features (Whittington et al., 2011). Wolves are the primary predator of mountain caribou (Edmonds, 1988; Seip, 1992; McNay, 2009; Whittington et al., 2011), but bears, cougars, and wolverine can be locally and/or seasonally important. Bear and wolverine predation are important sources of mortality in some caribou subpopulations (Cichowski and MacLean, 2005; McNay, 2009). Predation risk from wolves is often a function of increased access to caribou via linear corridors and increased density/altering distribution of wolves (Environment Canada, 2014). Additional linear development within the caribou RSA due to the Project is less than a 1% increase in linear density (km/km²) and therefore represents a small Project-related increase in potential wolf access to suitable caribou habitat (**Table 5.4.11-11**).

Table 5.4.11-11: Density of Linear Features within the Project Area

Study Area	Existing Roads		New Roads		Total Roads	
	Road Length	Road Density (km/km ²)	Road Length	Road Density (km/km ²)	Road Length	Road Density (km/km ²)
LSA	384	1.63	78	0.33	462	1.96
RSA	2917	0.66	104	0.04	2026	0.16
Tweedmuir Study Area	2122	0.16	67	0.01	2,189	0.16
Itcha-Ilgachuz Study Area	6249	0.66	0	<0.00	6,249	0.66

Note: ha = hectare; LSA = Local Study Area; RSA = Regional Study Area

Although not Project-related, changing weather and climatic conditions may also affect caribou populations. Some caribou specialists suggest that deep snow accumulation reduces wolf hunting effectiveness, thereby enhancing caribou survival, and that mild winters may be detrimental to predator avoidance by caribou (Edmonds and Smith, 1991). Severe winter snow depths or snow crusting conditions from mid-winter melting or ice storms may lead to greater caribou mortality and reduced calf production/survival. Significant spring snowpack may hinder adult female caribou migration to remote calving areas, possibly resulting in lower calf recruitment (Edmonds and Smith, 1991). It is likely that climate change could affect forest fires (frequency and severity), snow conditions, forage (amount and distribution), and predator-prey systems (Environment Canada, 2014). Wildfires in 2014 are impacting available moderate to high quality habitat within the Tweedsmuir subpopulation range. Changing climate and weather may also change timing of biting insect outbreaks to closer to calving periods, which may reduce fitness of calves. The potential effects of these factors on caribou numbers and distribution are largely unknown, but are likely negative.

5.4.11.3.7.4 Mortality Risk

The mine site access road, Kluskus FSR, and transmission corridor may increase the potential for direct mortality risk related to vehicle collisions and indirect effects related to increased predator efficiency and hunting access. The Kluskus FSR is a permanent feature on the landscape; however, traffic is expected to increase during Project operations causing a potential for a limited increase in direct mortality risk related to vehicle collisions, as the FSR occurs at the edge of the Tweedsmuir-Entiako subpopulation range. Effects have the potential to occur from the start of Project construction to closure. The airstrip and freshwater supply pipeline pose low mortality risk to caribou because they are expected to have negligible impact on the direct mortality of caribou.

5.4.11.3.8 Mitigation Measures

A range of habitat mitigation measures was adapted and applied to the Project as described in the WLMP (Section 12.2.1.18.4.6).

The Caribou Recovery Strategy (Environment Canada, 2014) identifies critical habitat necessary to achieve the population and distribution objectives for the recovery and survival of Southern Mountain caribou, which is partially identified as follows:

- All of the area of high elevation winter and/or summer range within the boundary of each local population unit (Tweedsmuir subpopulation is a local population unit and Itcha-Ilgachuz subpopulation is a component of the Chilcotin local population unit within the northern group of the Southern Mountain Population as per Environment Canada 2014);
- The area within the boundary of each local population unit in the northern and central groups that contains low elevation winter range providing an overall ecological condition that will allow for an ongoing recruitment and retirement cycle of habitat, which maintains a perpetual state of a minimum of 65% of the area as undisturbed;
- The area within the boundary of each local population unit that contains matrix range that provides an overall ecological condition that will allow for low predation risk defined as wolf population densities less than three wolves/1,000 km²; and
- Biophysical attributes required by Southern Mountain caribou to carry out life processes.

5.4.11.3.8.1 *Habitat Management*

A range of mitigation measures were adapted for the Project. Mitigation for unavoidable loss of caribou habitat is limited to that of the footprint area and includes strategies discussed in the WLMP (**Section 12.2.1.18.4.6**).

- Protecting high elevation caribou range as identified in the Caribou Recovery Strategy (Environment Canada, 2014) by discontinuing the use of existing mine access roads within UWR and re-routing the mine site access outside of caribou winter range;
- Activities that will occur outside of the caribou "least risk window" (as defined by the BC MOE Least Risk window to wildlife) will incorporate mitigation measures and an adaptive management approach, including stopping work if caribou are observed and combined with monitoring to ensure that displacement and impacts are reduced or avoided;
- Developing a compact site (minimize disturbance footprint) to reduce overall habitat loss and limit potential adverse effects related to sound emissions to the extent practical;
- Implementing progressive reclamation using local native vegetation wherever possible, or appropriate commercially grown, weed-free native species (LSVMP (**Section 12.2.1.18.4.4**), ISMP (**Section 12.2.1.18.4.5**), RCP (**Section 2.6**), and WLMP (**Section 12.2.1.18.4.6**));
- Restoring disturbed habitats at mine closure or developing habitats capable of supporting caribou to contribute to Recovery Strategy objectives of maintaining a minimum of 65% undisturbed habitat and by contributing to habitat that does not enhance alternate prey and increased wolf densities;
- Implementing caribou awareness and protocols in regular safety and environmental orientations performed by the mine. Workers and contractors will be made aware of seasonal changes in caribou behaviour or presence near the mine; and
- Implementing invasive plant management techniques as defined in the ISMP (**Section 12.2.1.18.4.5**); including developing and implementing detailed construction

and operational plans of invasive plant prevention and detection strategies, and an action protocol if invasive plants are detected. Management techniques will include annual monitoring for invasive plants.

5.4.11.3.8.2 *Mortality Risk*

Measures to reduce the potential for direct and indirect mortality risk include:

- Implementing dust control measures as defined in the AQEMP (**Section 12.2.1.18.4.9**), and avoiding use of road salts to reduce attractants that might draw caribou close to roads;
- Posting signs warning drivers of the possibility of caribou encounters in areas of high wildlife activity;
- Implementing BMPs for road surface maintenance to allow good vehicle line of sight and control to help reduce potential collisions with caribou. Selecting revegetation species that minimize attraction of wildlife to roadsides to reduce potential vehicle collisions, as well as help reduce changes in prey-predator densities and distribution;
- Enforcing speed limits along mine access roads to reduce potential wildlife collisions;
- Restricting and controlling mine road access to ensure no unauthorized traffic use of the road. All traffic flow on the FSR will be monitored and controlled via radio communications. Reporting observations of wildlife along the road to environmental staff;
- Implementing a no hunting and no firearms policy, as stated in the WLMP (**Section 12.2.1.18.4.6**); and
- Removing carrion along the road to reduce the risk of attractants that may bring predators into caribou habitat, as described in the WLMP (**Section 12.2.1.18.4.6**).

5.4.11.3.8.3 *Caribou Population Dynamics*

The following habitat mitigation measures apply to caribou and are specific to the potential effects of changes in caribou population dynamics such as predator-prey dynamics carried through the assessment:

- Placing natural cover such as rock piles and woody debris piles in open areas to reduce predator efficiency and create temporary visual cover for caribou, as part of the Closure and Reclamation Plan; and
- Placing woody debris on the surface of the upland slopes and between rocks and along the slopes, parallel and perpendicular with the slopes, to provide habitat features for security of caribou and to foster habitats not suitable for alternate prey species.

5.4.11.3.8.4 *Effectiveness of Mitigation*

Table 5.4.11-12 provides ratings for effectiveness of mitigation measures to avoid or reduce potential effects on caribou during mine site development. Prior to mine operation, the Proponent will define its contribution to regional management initiatives for ongoing research and monitoring of the Tweedsmuir-Entiako Northern Caribou subpopulation and their habitat use near the mine. Progress will be reported at least every three years through the operation of the mine in implementing the Proponent's contribution to regional initiatives and how the initiatives have influenced mine activities, undertakings, or works to the BC MOE and designated Aboriginal groups. Mitigation measures will be based on site-specific information and construction engineering and are therefore preliminary at this stage.

Table 5.4.11-12: Mitigation Measures and Effectiveness of Mitigation to Avoid or Reduce Potential Effects on Caribou during Mine Site Development

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
Habitat loss and alteration	Construction/ Operations/ Closure/Post-Closure	Protecting high elevation caribou range as identified in the Caribou Recovery Strategy by discontinuing the use of existing mine access roads within UWR and re-routing the mine site access outside of caribou winter range	High
		Activities that will occur outside of the caribou "least risk window" (as defined by the BC MOE Least Risk window to wildlife) will incorporate mitigation measures and an adaptive management approach, including stopping work if caribou are observed and combined with monitoring to ensure that displacement and impacts are reduced or avoided	High
		Developing a compact site (minimize disturbance footprint) to reduce overall habitat loss and limit potential adverse effects related to sound emissions to the extent practical	High
		Implementing progressive reclamation using local native vegetation wherever possible, or appropriate commercially grown, weed-free native species (LSVMP (Section 12.2.1.18.4.4), ISMP (Section 12.2.1.18.4.5), RCP (Section 2.6), and WLMP (Section 12.2.1.18.4.6))	Moderate
		Restoring disturbed habitats at mine closure or developing habitats capable of supporting caribou to contribute to Recovery Strategy objectives of maintaining a minimum of 65% undisturbed habitat and by contributing to habitat that does not enhance alternate prey and increased wolf densities	Moderate

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
		Implementing caribou awareness and protocols in regular safety and environmental orientations performed by the mine. Workers and contractors will be made aware of seasonal changes in caribou behaviour or presence near the mine	High
		Implementing invasive plant management techniques as defined in the ISMP (Section 12.2.1.18.4.5); including developing and implementing detailed construction and operational plans of invasive plant prevention and detection strategies, and an action protocol if invasive plants are detected. Management techniques will include annual monitoring for invasive plants.	High
Change in caribou mortality risk	Construction/ Operations/ Closure	Implementing dust control measures as defined in the AQEMP (Section 12.2.1.18.4.9), and avoiding use of road salts to reduce attractants that might draw caribou close to roads	High
		Posting signs warning drivers of the possibility of caribou encounters in areas of high wildlife activity; Implementing BMPs for road surface maintenance to allow good vehicle line of sight and control to help reduce potential collisions with caribou. Selecting revegetation species that minimize attraction of wildlife to roadsides to reduce potential vehicle collisions, as well as help reduce changes in prey-predator densities and distribution	Moderate
		Enforcing speed limits along mine access roads to reduce potential wildlife collisions	Moderate
		Restricting and controlling mine road access to ensure no unauthorized traffic use of the road. All traffic flow on the FSR will be monitored and controlled via radio communications. Reporting observations of wildlife along the road to environmental staff	Moderate
		Implementing a no hunting and no firearms policy, as stated in the WLMP (Section 12.2.1.18.4.6)	High
		Removing carrion along the road to reduce the risk of attractants that may bring predators into caribou habitat, as described in the WLMP (Section 12.2.1.18.4.6)	High

Likely Environmental Effect	Project Phase	Mitigation/Enhancement Measure	Effectiveness of Mitigation Rating
Changes in caribou population dynamics	Construction/ Operations/ Closure	Placing natural cover such as rock piles and woody debris piles in open areas to reduce predator efficiency and create temporary visual cover for caribou, as part of the Closure and Reclamation Plan	Low
		Placing woody debris on the surface of the upland slopes and between rocks and along the slopes, parallel and perpendicular with the slopes, to provide habitat features for security of caribou and to foster habitats not suitable for alternate prey species	Low

Note: AQEMP = Air Quality and Emissions Management Plan; BMP = Best Management Practice; FSR = Forest Service Road; ISMP = Invasive Species Management Plan; LSVMRP = Landscape, Soils and Vegetation Management and Restoration Plan; RCP = Reclamation and Closure Plan; UWR = Ungulate Winter Range; WLMP = Wildlife Management Plan

The mitigation/offsetting success ratings shown in **Table 5.4.11-12** are incorporated into the confidence ratings defined in **Section 4.3.5** and summarized in **Table 5.4.11-14**. In summary, low success rating means mitigation has not been proven successful, moderate success rating means mitigation has been proven successful elsewhere, and high success rating means mitigation has been proven effective.

In the case of caribou on the mine site, mitigation/offsetting success rating is classified as moderate overall because most mitigation measures are consistent with those proposed by BC MFLNRO and Environment Canada for protection and recovery of caribou populations, and demonstrated as moderate to high in effectiveness in other locations. Some measures such as those proposed to mitigate for changes in caribou population dynamics are rated low because these measures have only been implemented in recent years elsewhere, so effectiveness has not yet been demonstrated.

5.4.11.4 Residual Effects and their Significance

The residual effects after mitigation, as well as management strategies by Project phase and component, are summarized in **Table 5.4.11-13**.

Table 5.4.11-13: Summary of Category of Assessment and Mitigation Measures – Caribou

Project Phase	Project Component	Category of Assessment	Mitigation and Management	Potential for Residual Effect?
Construction, Operations, Closure, and Post-Closure	Mine site, access roads, freshwater supply pipeline, airstrip, and transmission line	Habitat Loss and Alteration	Vegetation Management Plan, progressive reclamation with appropriate species to accelerate reclamation of preferred caribou habitat through silviculture methods to promote ecosite restoration to pre-disturbance condition. Avoid large scale clearing of old-growth forest and lichen rich stands. Primary areas of concern are mature and old-growth forests in the mine site. Wetland compensation measures are expected to increase suitable horsetail habitat. Impacts to moderate to high value habitats are expected due to recovery time for lichen habitats. Minimize Project footprint. Measures to reduce displacement from roads, air traffic, and operations as per the WLMP. Adaptive measures to respond to presence of caribou in proximity to the mine.	Yes
Construction, Operations, and Closure	Mine site, access roads, freshwater supply pipeline, airstrip, and transmission line	Change in Caribou Mortality Risk	Follow Wildlife Management Plan to reduce potential effects on caribou and their habitat. Enforce speed limits on access roads. Restrict access to only individuals working directly for the Proponent. Gate site access points and initiate road closure after mine closure (Transportation and Access Management Plan). No hunting policy as stated in Wildlife Management Plan.	Yes
Construction, Operations, and Closure	Mine site, access roads, freshwater supply pipeline, airstrip, and transmission line	Changes in Caribou Population Dynamics	Vegetation management, reducing predator access and alternate prey through habitat management.	Yes

5.4.11.4.1 Significance of Residual Project Effects

Residual effects on caribou are characterized in terms of magnitude of effect, geographic extent of effect, duration of effect, reversibility, context and likelihood of effect on the VC or habitat, significance, and confidence in the conclusions (**Table 5.4.11-14**). The Caribou Recovery Strategy for the Woodland Caribou, Southern Mountain population (Environment Canada, 2014) identifies 65% undisturbed habitat (i.e., 35% disturbance) as a threshold. This threshold is recognized as a minimum, as it only provides a 60% probability for a local population to be self-sustaining (Environment Canada, 2011). For the purposes of this assessment, and taking a more conservative approach than the 35% cumulative total disturbance threshold for caribou, 20% was used as the precautionary disturbance threshold (i.e., 80% undisturbed) for determining the significance of the Project's residual effect on moderate to high value suitable habitat in the RSA and subpopulation area. With respect to considering cumulative effects, any residual loss of moderate to high value suitable caribou habitat in the RSA is considered important, and caribou habitat loss and alteration are carried forward to the CEA to determine loss relative to the Caribou Recovery Strategy objective of less than 35% cumulative total disturbance.

The thresholds provide the ability to likely detect change in magnitude in local subpopulations as a result of Project effects (**Table 5.4.11-15**).

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Table 5.4.11-14: Characterization of Residual Environmental Effects for Caribou

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Magnitude	The amount of change in a measurable parameter or variable relative to baseline case.	Negligible—Effects are not measurable Low—A measurable change but within the range of expected natural variation based on species life history Medium—A measurable change but less than high High ⁽¹⁾ — A >20% change of density, abundance or distribution for listed species and >30% change of density, abundance or distribution for all other species
Geographical Extent	The geographic area in which an environmental, economic, social, heritage, or health effect of a defined magnitude occurs.	Site-Specific: Within the Project Site—Local (e.g., effect is closely linked to the footprint but does not extend far outside of it); many wildlife effects extend into the LSA because they are referred to as local Local: Within the LSA—Effect is prevalent in the LSA; Landscape effects when the LSA tends to match with watersheds or larger units Regional: Within the RSA—Effect is prevalent in the RSA
Frequency	When the effect occurs and the number of times during the Project or a specific Project phase that an environmental effect may occur.	Once—Effect occurs on one occasion Intermittent—Effect occurs several times Continuous—Effect occurs continuously
Duration	The period of time required until the VC returns to its baseline condition or the effect can no longer be measured or otherwise perceived.	Short-term—Less than two years (i.e., effects happens during the construction phase only) Medium-term—Not applicable for caribou Long-term—From more than 17 to less than 35 years (i.e., effect happens during construction, operations and closure) Chronic—More than 35 years and beyond (i.e., effect happens from construction through to post closure and beyond)
Reversibility	The likelihood that a measurable parameter will recover from an effect.	Yes—Effect is reversible within part of a whole generation after the impact ceases (VC- and impact-dependent) No—Effect is not reversible over the timescales listed

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Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Context	Resilience to stress due to ecological fragility and degree of disturbance of area in which the Project is located.	Low—Caribou has high resilience to stress; have not been affected by other projects or activities or natural changes. No listed species or ecosystems identified Medium—Caribou has moderate resilience to stress, the VC has been affected by other projects or activities, or natural changes but still has capacity to assimilate more changes. Presence of blue-listed species or ecosystems High—Caribou has weak resilience to stress, the VC has been severely affected by other projects or activities, or natural changes. Presence of red-listed or SARA-listed species or ecosystems.
Likelihood of Effect	The likelihood that a residual effect will occur.	Low—Low likelihood a residual effect will occur Moderate—Medium likelihood a residual effect will occur High—High likelihood a residual effect will occur
Significance	Expectation of a residual effect on the VC that is above the suggested threshold.	Not Significant (negligible)—Effects are point-like or local in geographic extent; low context rating; negligible magnitude; short-term; reversible; low frequency (once or intermittent) Not Significant (minor)—Effects are local in geographic extent; low magnitude; low context rating; short-term to chronic; reversible; low frequency (once or intermittent) Not Significant (moderate)—Effects are local to regional in geographic extent; medium in magnitude; medium context rating; medium-term to chronic; reversible; and occur at all frequencies Significant—Effects occur to caribou with a medium to high context rating; high magnitude; regional in geographic extent; long-term to chronic; non-reversible; and occur at all frequencies
Confidence Level	Confidence in the residual effects prediction.	Low—VC is not well understood; Project-VC interaction is not well understood; mitigation has not been proven effective Moderate—VC understood in similar ecosystems and effects documented in the larger regional area or in the literature; mitigation proven effective elsewhere High—VC is well understood; Project-VC interaction is well understood; mitigation has been proven effective

Note: LSA = Local Study Area; RSA = Regional Study Area; SARA = *Species at Risk Act*; VC = Valued Component
 High: A threshold of 20% change or loss is proposed for high magnitude. This is a general environmental practitioner approach, which has been used and supported in the past for resource development projects, including the Joint Review Panel Report on the Jackpine Mine Expansion Project which decision statement was made under *CEAA 2012*.

Table 5.4.11-15: Threshold(s) for Determining Magnitude of Residual Caribou Habitat and Population Effects in the RSA

Category of Assessment	Thresholds of Environmental Effect
Habitat Loss and Alteration	Reduction in relative caribou habitat abundance or habitat areas with a moderate to high suitability ratings within the RSA, as estimated in suitability model. Potential avoidance or displacement due to sensory disturbance is included as lost habitat if evident. Any residual habitat loss will be carried forward to the CEA. A threshold of 20% loss of moderate to high value habitat was set for significance of Project effects.
Mortality Risk	Qualitative measure of risk within the RSA because of Project effects (e.g., road density and relative frequency of use of the area by caribou). Magnitude for the transmission line effect is expressed quantitatively as a linear feature density (as km/km ² and percent change). Magnitude for the access road effect is defined as: Low - no caribou are killed during the life of the Project as the result of collisions with Project-related traffic; Medium - one caribou is killed during the life of the Project as the result of collisions with Project-related traffic; and High - more than one caribou is killed during the life of the Project as the result of collisions with Project-related traffic. Increased direct mortality risk for caribou associated with the transmission line and along the access road is predicted to be negligible. Provincial wildlife mortality data do not indicate any reported caribou mortality for these subpopulations related to direct road mortality.
Changes in Caribou Population Dynamics	Greater than 10% reduction in caribou numbers/density because of proposed Project effects within the RSA; increase in wolf density from project effects (greater than 3 wolves/1,000 km ² in the regional area is a regional threshold identified by the Caribou Recovery Strategy (Environment Canada, 2014)).

Note: CEA = cumulative effects assessment; km² = square kilometres
 RSA = Regional Study Area modified for caribou

Based on the categorization of effects, the residual effects assessment summary for caribou is provided in **Table 5.4.11-16**.

Table 5.4.11-16: Residual Effects Assessment Summary for Caribou

Project Phase	Project Component	Category of Assessment	Mitigation and Management	Potential for Residual Effect?	Residual Effect	Context	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Likelihood Determination	Level of Confidence for Likelihood	Significance Determination	Level of Confidence for Significance
Construction through to Post-closure	Mine site, airstrip, transmission line, freshwater supply pipeline, and access roads	Habitat Loss and Alteration	Vegetation Management Plan; progressive reclamation with appropriate species; maintain forest function and vegetation cover, particularly lichen-bearing forest and terrestrial lichens; reduce sensory disturbance as per the Wildlife Management Plan.	Yes	Unavoidable loss of lichen habitat during the life of the Project	High	Low	Local	Chronic	Reversible	One time	High	High	Not Significant (moderate)	High
Construction through to Closure	Mine site, airstrip, transmission line, freshwater supply pipeline, and access roads	Mortality Risk	Mitigation measures to reduce mortality and access from roads.	Yes	Direct mortality from collisions or poaching	High	Low	Local	Long-term	Reversible	Intermittent	Low	High	Not Significant (negligible)	High
Construction through to Closure	Mine site, airstrip, transmission line, freshwater supply pipeline, and access roads	Changes in Caribou Population Dynamics	Vegetation management.	Yes	Unavoidable indirect mortality of caribou due to increases in prey density or wolves	High	Low	Local	Long-term	Reversible	Intermittent	Low	High	Not Significant (minor)	High

5.4.11.4.1.1 *Mine Site*

The residual effects of habitat loss are rated as Not Significant (moderate) with high confidence, due to the magnitude, geographical extent, frequency, and reversibility of the effect occurring.

The loss and degradation of a maximum of 3,447 ha of moderate to high value caribou spring habitat, 3,784 ha of moderate to high value summer/fall habitat, and 3,723 ha of moderate to high value winter habitat will occur during the construction phase and these effects will be evident through to the closure and post-closure phases due to slow anticipated recovery of lichens.

Within the mine site, the adverse effect is rated as low magnitude because a small fraction (5%) of available habitat within the RSA will be affected and the resilience to recovery for these ecosystems is moderate. Regionally, these moderate to high value habitats are available throughout the subpopulation range. The clearing of trees from forested habitats will generally create less suitable habitat for caribou, as lichen-bearing trees and terrestrial lichens that are important to caribou will not be available. Habitat effects will be primarily limited to the mine site footprint and sensory disturbance will be limited to the LSA. The duration of the habitat effect will be chronic until lichen areas are reclaimed during post-closure; however, some areas will be revegetated before closure thereby reducing the time the habitat is lost. Caribou habitat is moderate to respond and slow to recover from disturbances. Once habitat loss and alteration occurs during construction, it will be approximately 17 years before closure and then at least 80 or more years for the forested ecosystems to reach a mature forest of structural stage 6 and lichens are re-established, similar to baseline conditions, therefore extending the duration to chronic.

The habitat effect will occur once and will be reversible in the long term and chronic in post-closure. There is a high likelihood that permanent loss of some moderate to high value habitat will occur after reclamation and a low likelihood that increased wolf predation due to changes in population dynamics may occur related to habitat alteration. The long-term recovery from habitat disturbance results in caribou having a high ecological resilience. Caribou have evolved in a fire-driven landscape and can readily respond to temporary habitat disturbance provided there is sufficient alternate functional habitat supply to support the local population while the disturbed habitat recovers and provided the landscape connectivity within the population range is not compromised. Project activities are not expected to affect the viability of caribou or caribou habitat in the RSA, due to the extent of caribou and habitat within subpopulation areas outside of the RSA; however, due to the concern for caribou recovery, habitat loss and changes to population dynamics are carried forward to the CEA.

The residual effects of mortality are rated as Not Significant (negligible) with high confidence, due to the magnitude, geographical extent, frequency, and reversibility of the effect occurring. Changes in mortality will occur intermittently from the construction phase through the closure phase. Mortality changes have a local effect within the mine site. The adverse effect is rated with low magnitude because the increase in mortality due to Project activities is considered low. Direct Project mortality is anticipated to mostly result from vehicle collisions; however, additional mortality may result from other activities (e.g., accidental chemical spills, poaching). Project effects will be reversible; however, the duration of the habitat effect will be long-term as recovery of lichen

habitats is expected to last for the length of the Project. The effects will have a high context due to the low resilience of the ecosystems present to recover from disturbance.

The residual effects of a change in population dynamics are rated as Not Significant (minor) with high confidence, due to the magnitude, geographical extent, frequency, and reversibility of the effect occurring. Changes in population dynamics will occur intermittently from the construction phase through the closure phase. Changes in population dynamics will be local in geographic extent due to changes in foraging habitat and predator populations in areas of the mine site. Clearing of vegetation may result in increased foraging habitat, which could result in changes to local moose populations which may affect predators and caribou. In addition, clearing may increase access for predators to certain areas within the mine site and increase the risk of predation for caribou within these areas. The adverse effect within the mine site is rated with low magnitude because the changes in population dynamics due to Project activities are expected to be minimal. Project effects will be reversible; however, the duration of changes in population dynamics will be long-term as some the effects are expected to last for the length of the Project. The effects will have a high context due to the low resilience of the ecosystems present to recover from disturbance.

5.4.11.4.1.2 Proposed Access Road and Kluskus Forest Service Road

The residual effects of habitat loss are rated as Not Significant (minor) with high confidence, due to the magnitude, geographical extent, frequency, and reversibility of the effect occurring. The loss and degradation of caribou habitat, adverse sensory disturbance, and potential for loss due to predation related to changes in predator-prey dynamics will occur along roads associated with the Project. The loss and degradation of caribou habitat will occur during the construction phase and these adverse effects will be evident through to the closure and post-closure phases. The existing Kluskus FSR will remain in place. Within the mine access road, the adverse effect is rated as low magnitude because a small fraction of available habitat will be affected relative to habitats where caribou may occur and the sensitivity to recovery for these ecosystems is high. The existing mine access road within the UWR is planned to be closed except for emergencies, and re-routed outside of the UWR to reduce potential effects on caribou. The Kluskus FSR is an existing road, and no additional habitat will be affected.

The habitat effect will occur once and will be reversible during post-closure once all of the mitigation and reclamation are completed. There is a predicted high likelihood that loss of some moderate value habitat will occur and a low likelihood that sensory displacement, degradation of habitat, or increased predation will occur. Project activities are not predicted to affect the viability of caribou near the existing FSR or proposed mine access road within the RSA.

The residual effects of mortality are rated as Not Significant (negligible) with high confidence, due to the magnitude, geographical extent, frequency, and reversibility of the effect occurring. Changes in mortality will occur intermittently from the construction phase through the closure phase. Mortality changes have a local effect within the Kluskus FSR and mine access road. The adverse effect is rated with low magnitude because the increase in mortality due to Project activities is considered low. Direct Project mortality is anticipated to mostly result from vehicle collisions; however, additional mortality may result from other activities (e.g., accidental chemical spills,

poaching). Project effects will be reversible; however, the duration of the habitat effect will be long-term as recovery of lichen habitats is expected to last for the length of the Project. The effects will have a high context due to the low resilience of the ecosystems present to recover from disturbance.

The residual effects of a change in population dynamics are rated as Not Significant (minor) with high confidence, due to the magnitude, geographical extent, frequency, and reversibility of the effect occurring. Changes in population dynamics will occur intermittently from the construction phase through the closure phase. Changes in population dynamics will be local in geographic extent due to changes in foraging habitat and predator populations in areas of the access road and Kluskus FSR. Clearing of vegetation may result in increased foraging habitat, which could result in changes to local moose populations, which may affect predators and caribou. In addition, roads may increase access for predators to certain areas within the mine site and increase the risk of predation for caribou within these areas. The adverse effect within the mine site is rated with low magnitude because the changes in population dynamics due to Project activities are expected to be minimal. Project effects will be reversible; however, the duration of changes in population dynamics will be long-term as some the effects are expected to last for the length of the Project. The effects will have a low context due to the high resilience of the ecosystems present within the Project to recover from disturbance and limited use of these areas by caribou.

5.4.11.4.1.3 Airstrip, Transmission Line, and Freshwater Supply Pipeline

The residual effects of habitat loss are rated as Not Significant (minor) with high confidence, due to the magnitude, geographical extent, frequency, and reversibility of the effect occurring. The loss and degradation of caribou habitat, adverse sensory disturbance, and potential for loss due to predation related to changes in predator-prey dynamics will occur within the airstrip, transmission line, and freshwater supply pipeline areas, and these adverse effects will be evident over chronic duration. The habitat effects for the airstrip and freshwater supply pipeline have a low magnitude rating because much of the area is already disturbed by logging and many of the mitigation practices implemented in the Closure and Reclamation Plan will minimize the majority of effects. The effects for the transmission line will have a low magnitude in previously logged areas along the FSR.

The habitat effect will occur once and will be reversible during post-closure. There is a low likelihood that sensory displacement, degradation of habitat, or increased predation will occur. Project activities are not predicted to affect the viability of caribou near the existing FSR and proposed access road within the RSA.

The residual effects of mortality are rated as Not Significant (negligible) with high confidence, due to the magnitude, geographical extent, frequency, and reversibility of the effect occurring. Changes in mortality will occur intermittently from the construction phase through the closure phase. Mortality changes have a local effect within the airstrip, transmission line and freshwater supply pipeline. The adverse effect is rated with low magnitude because the increase in mortality due to Project activities is considered low. Direct Project mortality is anticipated to mostly result from vehicle collisions; however, additional mortality may result from other activities (e.g., accidental chemical spills, hunting, poaching). Project effects will be reversible; however, the duration of the

habitat effect will be long-term as recovery of lichen habitats is expected to last for the length of the Project. The effects will have a high context due to the low resilience of the ecosystems present to recover from disturbance.

The residual effects of a change in population dynamics are rated as Not Significant (negligible) with high confidence, due to the magnitude, geographical extent, frequency, and reversibility of the effect occurring. Changes in population dynamics will occur intermittently from the construction phase through the closure phase. Changes in population dynamics will be local in geographic extent due to changes in foraging habitat and predator populations. Clearing of vegetation may result in increased foraging habitat, which could result in changes to local moose populations which may affect predators and caribou. In addition, increased access for predators to the airstrip, transmission line and freshwater supply pipeline may increase the risk of predation for caribou within these areas. The adverse effect is rated with low magnitude because the changes in population dynamics due to Project activities in these areas are expected to be minimal. Project effects will be reversible; however, the duration of changes in population dynamics will be long-term as some the effects are expected to last for the length of the Project. The effects will have a low context due to the high resilience of the ecosystems present within the Project to recover from disturbance and limited use of these areas by caribou.

5.4.11.4.1.4 Project Area

For the Project as a whole, the residual effects of habitat loss are rated at Not Significant (moderate) with high confidence, due to the magnitude, geographical extent, frequency, and reversibility of the effect. The loss and degradation of moderate to high value caribou habitat will occur during the construction phase primarily in the mine site area and these effects will be evident in the closure and post-closure phases due to slow anticipated recovery of lichens. Within the mine site, the adverse effect is rated as low magnitude because a small fraction of regionally available habitat will be affected. Regionally, these moderate to high value suitable habitats are widespread and available throughout the RSA and subpopulation areas. A small amount of available moderate to high quality habitat (5%) will be affected relative to that available in the RSA. Habitat effects will be primarily limited to the mine site footprint, and sensory disturbance will be limited to the LSA. The duration of the habitat effect will be chronic until lichen areas can be reclaimed post-closure; however, some areas will be revegetated before closure, reducing the duration that habitat is lost. Caribou habitat is slow to respond and recover from disturbances. Once habitat loss and alteration occur during construction, it will be approximately 17 years before closure and then at least 80 or more years for the forested ecosystems to reach a mature forest of structural stage 6 and lichens are re-established, similar to baseline conditions, thereby extending the duration to chronic. The habitat effect will occur once and will be reversible in the long term and chronic in post-closure.

The residual effects of mortality for the Project are rated as Not Significant (negligible) with high confidence, due to the magnitude, geographical extent, frequency, and reversibility of the effect occurring. Changes in mortality will occur intermittently from the construction phase through the closure phase. Mortality changes have a local effect within the mine site. The adverse effect is rated with low magnitude because the increase in mortality due to Project activities is considered low. Direct Project mortality is anticipated to mostly result from vehicle collisions; however, additional mortality may result from other activities (e.g., accidental chemical spills, hunting,

poaching). Project effects will be reversible; however, the duration of the habitat effect will be long-term as recovery of lichen habitats is expected to last for the length of the Project. The effects will have a high context due to the low resilience of the ecosystems present to recover from disturbance.

The residual Project effects of a change in population dynamics are rated as Not Significant (minor) with high confidence, due to the magnitude, geographical extent, frequency, and reversibility of the effect occurring. Changes in population dynamics will occur intermittently from the construction phase through the closure phase. Changes in population dynamics will be local in geographic extent due to changes in foraging habitat and predator populations in areas of the mine site. Clearing of vegetation may result in increased foraging habitat, which could result in changes to local moose populations, which may affect predators and caribou. In addition, clearing may increase access for predators to certain areas within the mine site and increase the risk of predation for caribou within these areas. The adverse effect within the mine site is rated with low magnitude because the changes in population dynamics due to Project activities are expected to be minimal. Project effects will be reversible; however, the duration of changes in population dynamics will be long-term as some the effects are expected to last for the length of the Project. The effects will have a high context due to the low resilience of the ecosystems present to recover from disturbance. Project activities are not expected to affect the viability of caribou, due to the extent of caribou and their habitat within subpopulation areas outside of the RSA; however, due to the concern for caribou recovery, habitat loss and changes to population dynamics are carried forward to the CEA.

5.4.11.5 Cumulative Effects

A CEA for caribou within the RSA was conducted because of the following conditions:

- Residual effects on caribou habitat and population dynamics are rated Not Significant (moderate or minor) based on the Project components and the interaction with caribou within the RSA;
- Residual effects on caribou have valid links with the effects of other past, present, or future activities within the RSA. Logging activities have caused loss of habitat within the RSA and, combined with loss of habitat due to wildfire and MPB infestation, a substantial amount of suitable habitat has been or will be negatively affected for both caribou subpopulations. There is a valid link between the Project effects and the effects of other activities within the RSA and Tweedsmuir-Entiako subpopulation range. Although potential residual effects of the Project are low (1% to 4% of available spring and summer habitats before reclamation, during seasons when trace numbers of caribou were detected within the RSA), these effects would contribute to the Caribou Recovery Strategy threshold of 35% disturbance of Type I Matrix Habitat (Environment Canada, 2014). **Appendix 5.4.11C** includes a habitat supply analysis for the subpopulations and identifies predation, MPB, fire, forestry and other cumulative effects as critical factors to consider in developing effective action plans for recovery of caribou; and

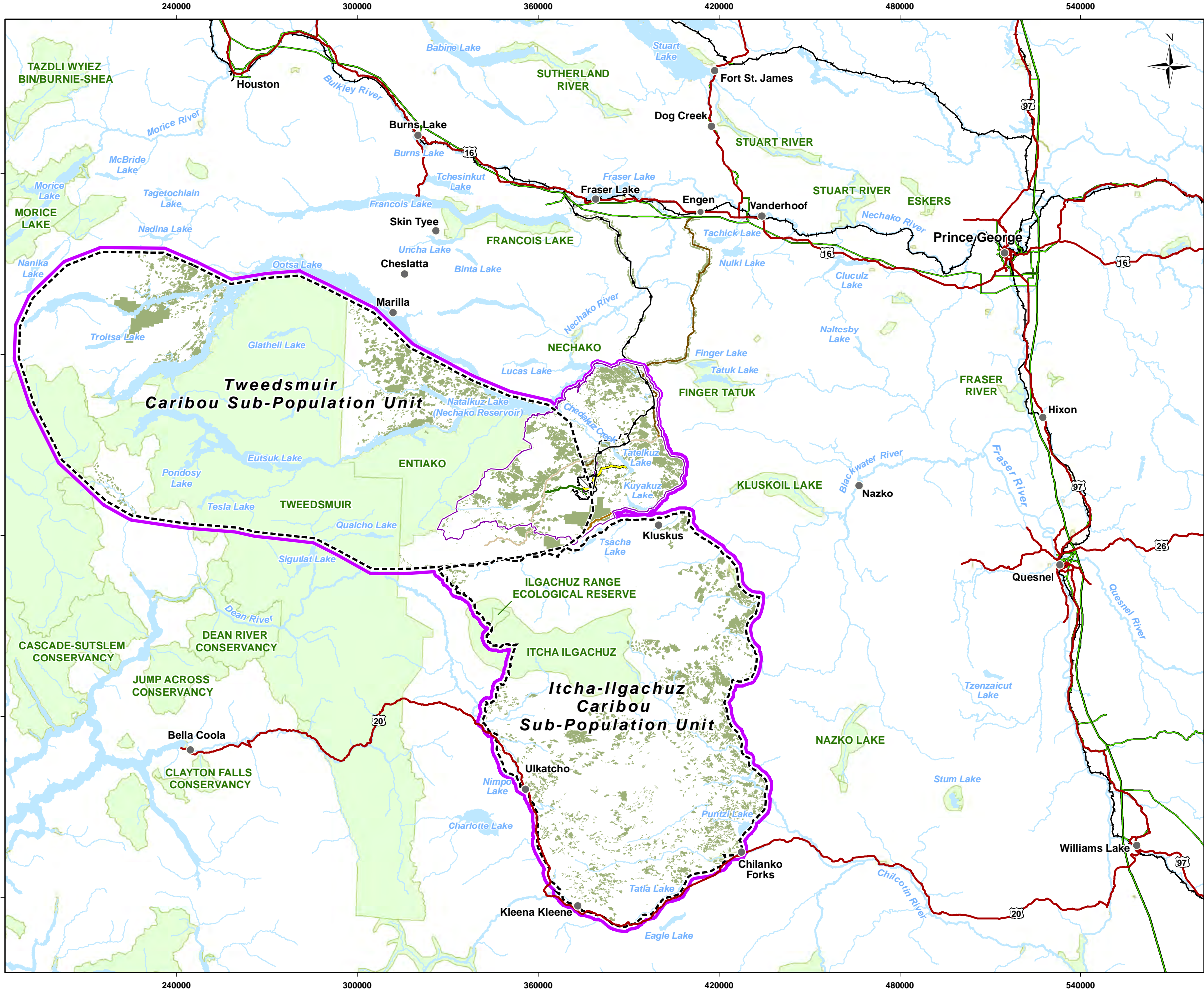
BLACKWATER GOLD PROJECT

APPLICATION FOR AN
ENVIRONMENTAL ASSESSMENT CERTIFICATE /
ENVIRONMENTAL IMPACT STATEMENT
ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS



- A primary consideration in the assessment of caribou populations is the density of linear development. Several existing features overlap the wildlife cumulative effects areas relative to the caribou subpopulation areas (**Figure 5.4.11-6 to Figure 5.4.11-10**).

The residual Project effects of baseline habitat loss and changes to population dynamics are carried forward into the CEA, as these effects will overlap in space and time with the residual effects of other projects (**Table 5.4.11-16**). **Table 5.4.11-17** presents the rationale for carrying the effect forward into the CEA. Cumulative effects are assessed for the habitat loss and alteration RSA (where suitability modelling allows detailed estimates of habitat quality loss) for the Tweedsmuir-Entiako caribou subpopulation that may be directly affected by the Project effects and for the Itcha-Ilgachuz subpopulation because of potential connectivity value through matrix habitat in the mine RSA. As a result, the CEA spatial boundary includes the habitat loss and alteration RSA for assessment of moderate to high value habitat directly affected by the Project (**Figure 5.4.11-8 and Figure 5.4.11-9**). The caribou subpopulation boundaries are used for CEA as they are the units defined by Environment Canada (2014) for Caribou Recovery Strategy objectives.



Legend

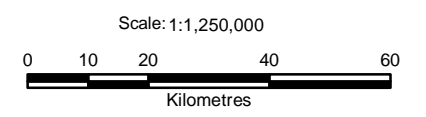
- Populated Place
- 16 Highway
- Kluskus FSR
- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Existing Transmission Line
- Streams
- Waterbody
- Parks and Protected Areas
- Forest Cutblocks

Project Components

- Exploration Road
- Proposed Mine Access Road
- Proposed Transmission Line
- Proposed Transmission Line re-route
- Proposed Water Pipeline Route
- Proposed Airstrip Access Road
- Proposed Airstrip Extent
- ▨ Proposed Mine Site

Caribou

- ▭ Regional Study Area
- ▭ Area Used for Habitat Loss and Alteration Analysis
- ▭ Caribou Sub-Population Unit



Reference
 BC Government GeoBC Data Distribution
 Caribou Sub-Population Units are shown only for features used in analysis

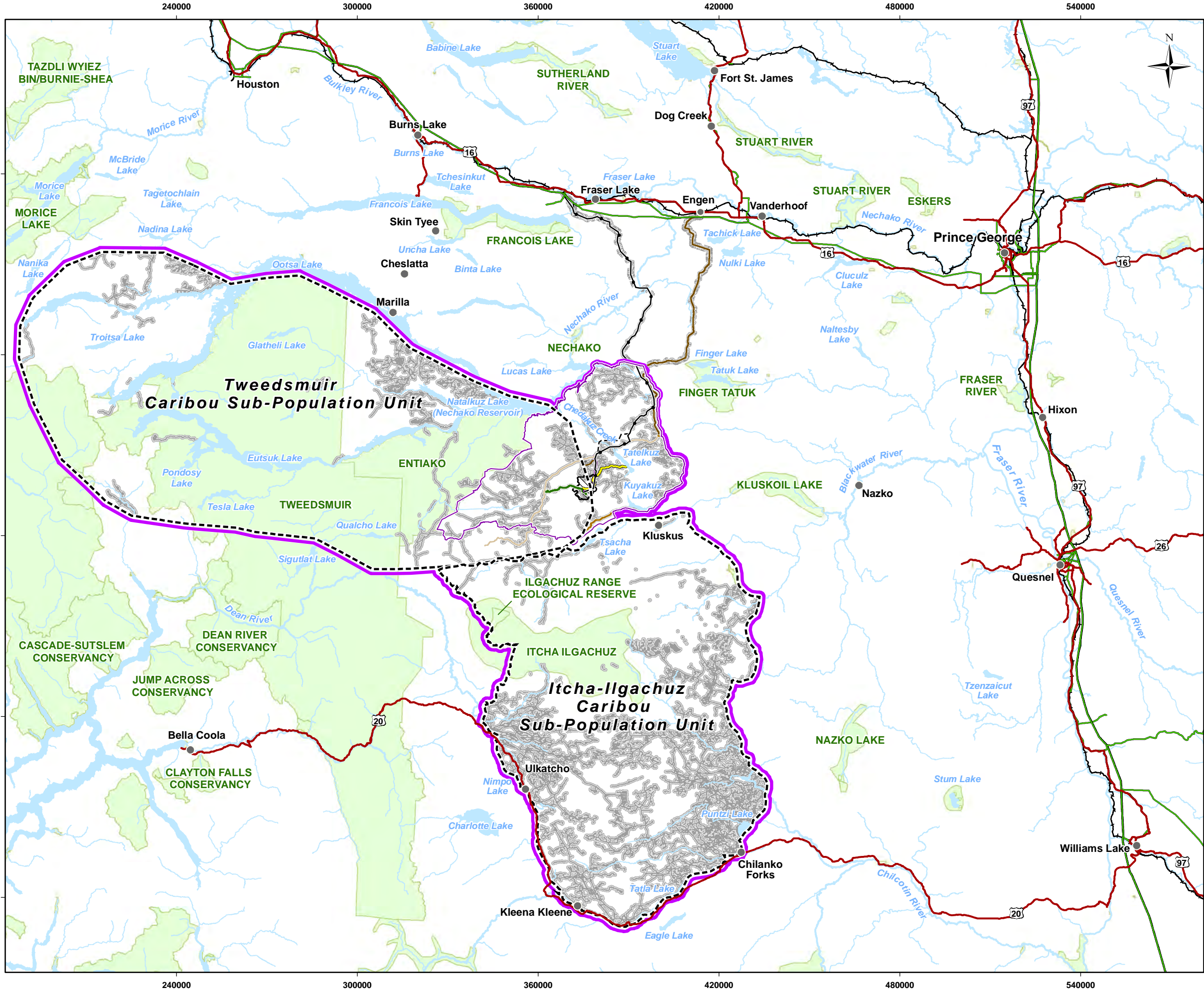
CLIENT:

PROJECT: **Blackwater Gold Project**

**Cumulative Effects:
 Caribou
 Forest Cutblocks**

DATE: September, 2015	ANALYST: MY	Figure 5.4.11-6
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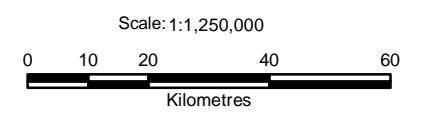
- Populated Place
- 16 Highway
- Kluskus FSR
- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Existing Transmission Line
- Streams
- Waterbody
- Parks and Protected Areas
- Roads - Footprint
- Roads - 500m Buffer

Project Components

- Exploration Road
- Proposed Mine Access Road
- Proposed Transmission Line
- - - Proposed Transmission Line re-route
- Proposed Water Pipeline Route
- Proposed Airstrip Access Road
- Proposed Airstrip Extent
- ▨ Proposed Mine Site

Caribou

- ▭ Regional Study Area
- ▭ Area Used for Habitat Loss and Alteration Analysis
- - - Caribou Sub-Population Unit



Reference
 BC Government GeoBC Data Distribution
 Caribou Sub-Population Units are shown only for features used in analysis

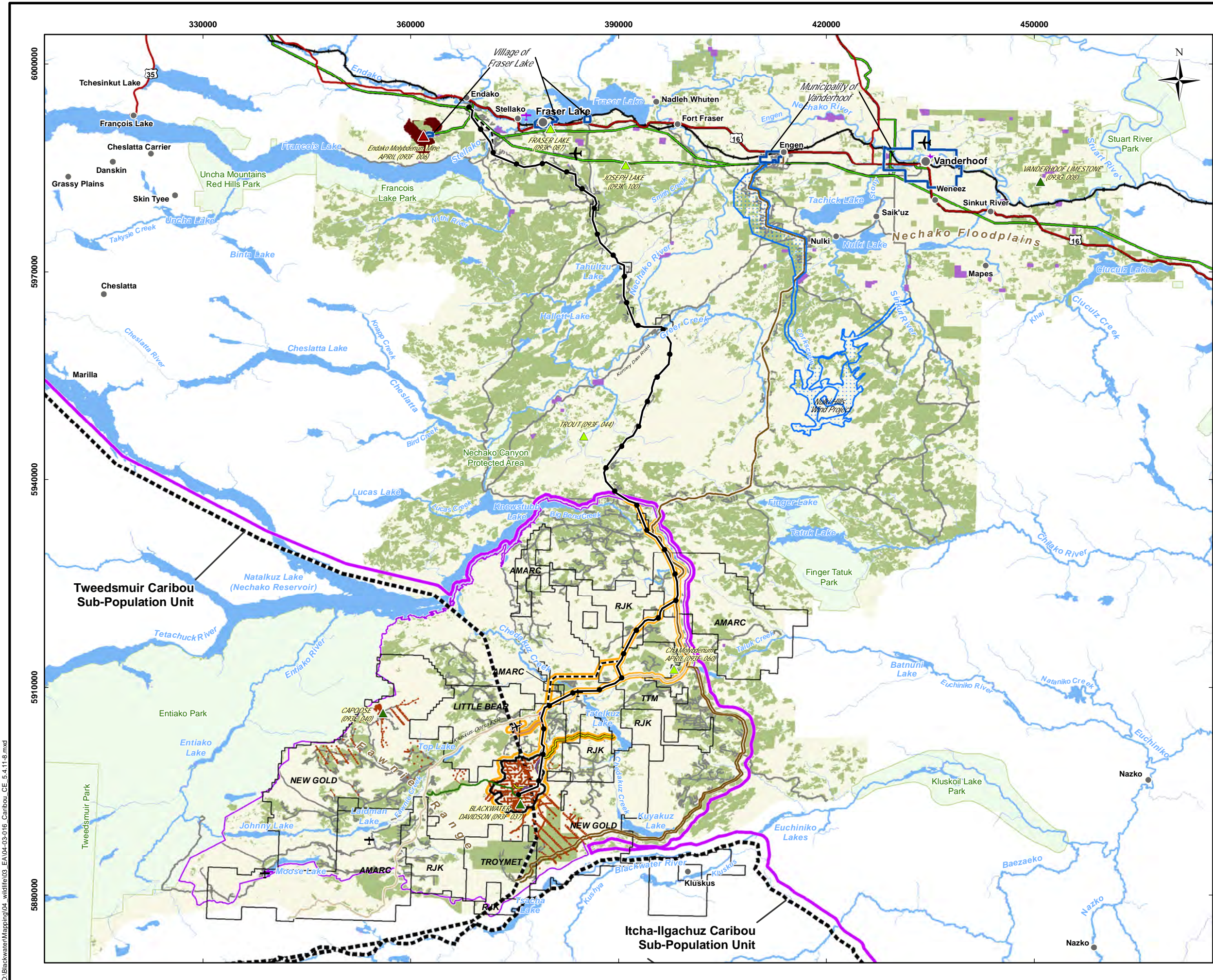
CLIENT:

PROJECT: **Blackwater Gold Project**

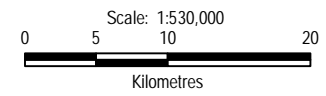
**Cumulative Effects:
 Caribou
 Road Features**

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GIS FILE: 04-03-015_Caribou_Road_5.4.11-7.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	

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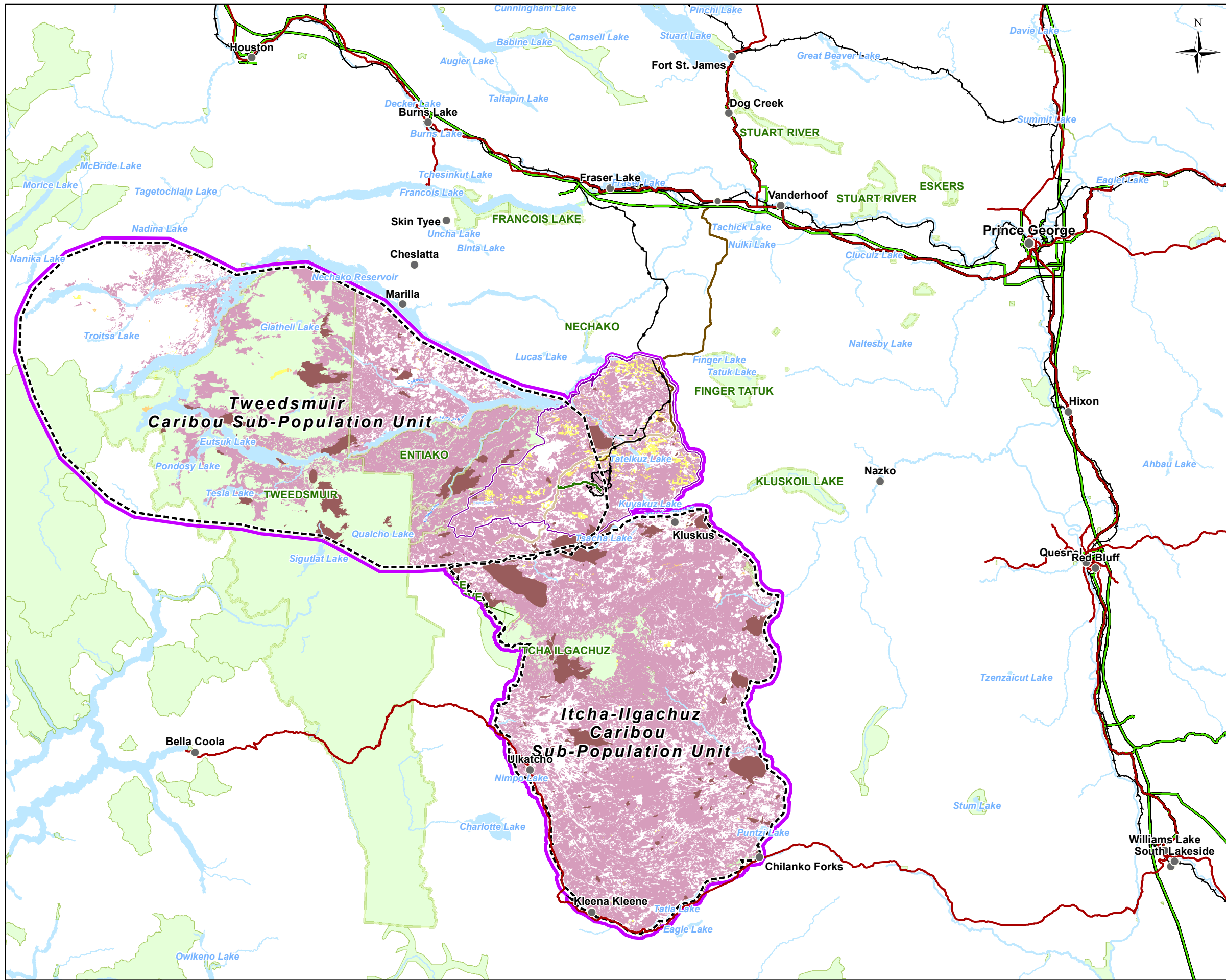
- Legend**
- Populated Place
 - Highway
 - Kluskus-Blue FSR
 - Other FSRs
 - Parks
 - Municipal Boundaries
- PROJECT COMPONENTS**
- ✈ Proposed Airstrip
 - Exploration Road
 - Proposed Transmission Line
 - Proposed Re-routes (Stellako, Mills Ranch)
 - Proposed Freshwater Supply System
 - Proposed Airstrip Access Road
 - Proposed Airstrip Extent
 - Proposed Mine Site
- FORESTRY**
- Forest Cutblocks
- INFRASTRUCTURE**
- ✈ Airport
 - ✈ Airstrip
 - ✈ Waterdome
 - Nulki Hills Wind Project
- MINING**
- Mineral Deposits**
- ▲ Producer
 - ▲ Developed Prospect
 - ▲ Prospect
- Mining Activities**
- Active Mining
 - Current Prospecting
 - Quarries (Tenure Purpose)
- Mineral Tenures**
- Currently prospecting
- Caribou**
- Caribou Local Study Area
 - Caribou Regional Study Area
 - Area Used for Habitat Loss and Alteration Analysis
 - Caribou Sub-Population Unit



Reference
 BC Government GeoBC Data Distribution
 NRCAN Geobase
 Ministry of Forests, Lands and Natural Resource Operations

CLIENT: 		
PROJECT: Blackwater Gold Project		
Cumulative Effects: Caribou Mining, Forestry and Infrastructure		
DATE: September, 2015	ANALYST: KA	Figure 5.4.11-8
JOB No: VE52277	QA/QC: MY	PDF FILE: 04-03-016_Caribou_CE_5.4.11-8.pdf
GIS FILE: 04-03-016_Caribou_CE_5.4.11-8.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	

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Legend

- Populated Place
- Highway
- Railway
- Existing Transmission Line
- Kluskus FSR
- Kluskus-Ootsa FSR
- Stream
- Waterbody
- Parks and Protected Areas

Project Components

- Exploration Road
- Proposed Transmission Line
- - - Proposed Transmission Line re-route
- Proposed Airstrip Access Road
- Proposed Airstrip Extent
- ▨ Proposed Mine Site

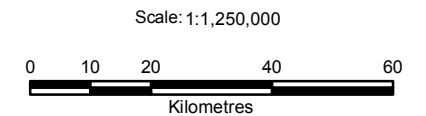
MPB Attack Severity (% of Stand Affected)

MPB Attack Severity

- Severe
- Moderate
- Low
- Fire Extent - 1960 to 2013

Caribou

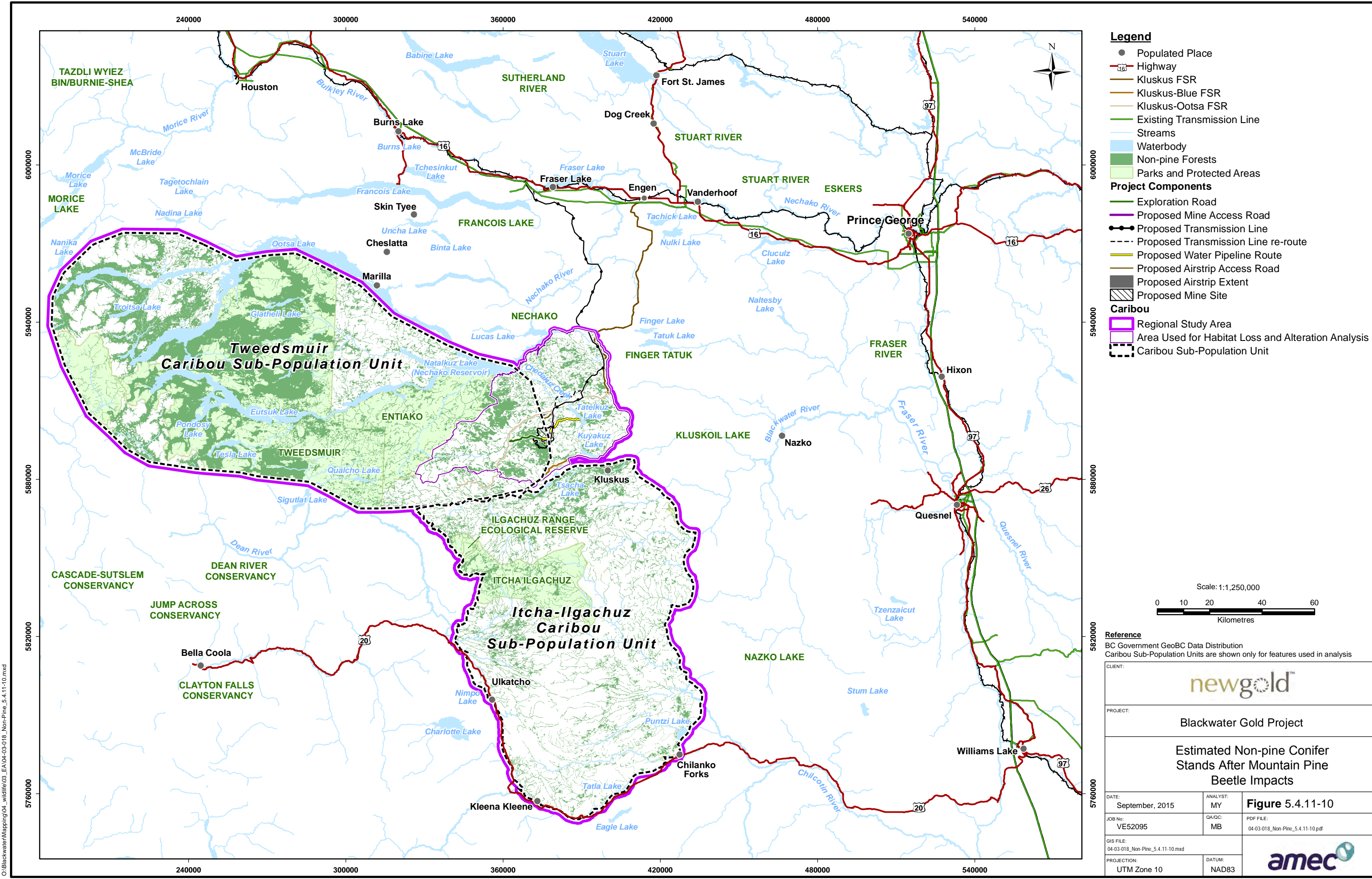
- Caribou Regional Study Area
- Area Used for Habitat Loss and Alteration Analysis
- Caribou Sub-Population Unit



Reference
 BC Government GeoBC Data Distribution
 Caribou Sub-Population Units are shown only for features used in analysis

CLIENT: 		
PROJECT: Blackwater Gold Project		
Cumulative Effects: Caribou Herd Boundary Mtn. Pine Beetle - Severity of Attack		
DATE: March, 2014	ANALYST: KA	Figure 5.4.11-9
JOB No: VE52095	QA/QC: MY	PDF FILE: 11-200-068_Caribou_MPB_v2.pdf
GIS FILE: 11-200-068_Caribou_MPB_v2.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	

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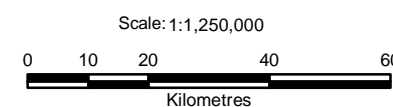
- Populated Place
- 16 Highway
- Kluskus FSR
- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Existing Transmission Line
- Streams
- Waterbody
- Non-pine Forests
- Parks and Protected Areas

Project Components

- Exploration Road
- Proposed Mine Access Road
- Proposed Transmission Line
- - - Proposed Transmission Line re-route
- Proposed Water Pipeline Route
- Proposed Airstrip Access Road
- Proposed Airstrip Extent
- ▨ Proposed Mine Site

Caribou

- ▭ Regional Study Area
- ▭ Area Used for Habitat Loss and Alteration Analysis
- - - Caribou Sub-Population Unit



Reference
 BC Government GeoBC Data Distribution
 Caribou Sub-Population Units are shown only for features used in analysis

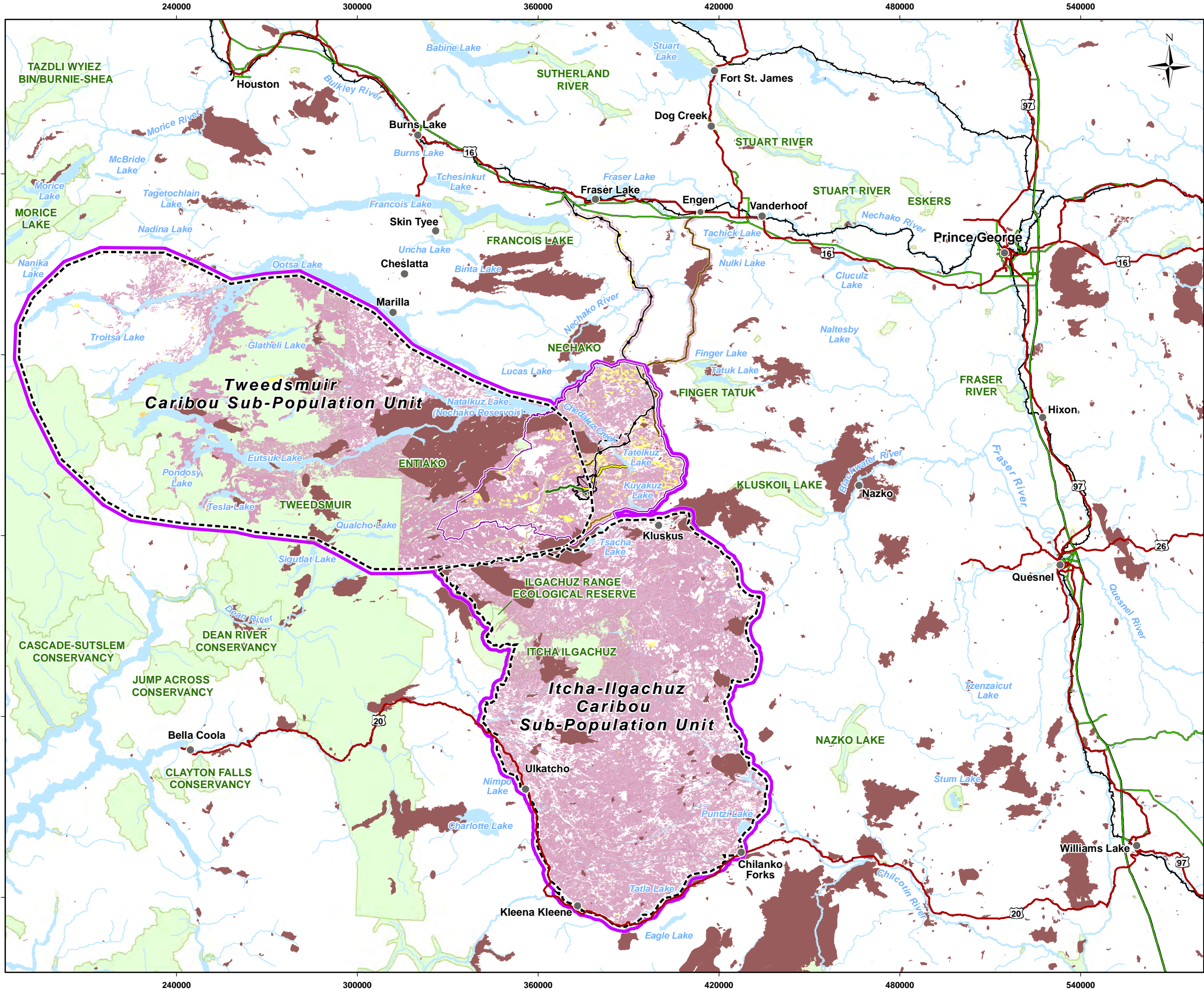
CLIENT:

PROJECT: **Blackwater Gold Project**

Estimated Non-pine Conifer Stands After Mountain Pine Beetle Impacts

DATE: September, 2015	ANALYST: MY	Figure 5.4.11-10
JOB No: VE52095	QA/QC: MB	PDF FILE: 04-03-018_Non-Pine_5.4.11-10.pdf
GIS FILE: 04-03-018_Non-Pine_5.4.11-10.mxd		
PROJECTION: UTM Zone 10	DATUM: NAD83	

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Legend

- Populated Place
- 16 Highway
- Kluskus FSR
- Kluskus-Blue FSR
- Kluskus-Ootsa FSR
- Existing Transmission Line
- Streams
- Waterbody
- Parks and Protected Areas

Project Components

- Exploration Road
- Proposed Mine Access Road
- Proposed Transmission Line
- Proposed Transmission Line re-route
- Proposed Water Pipeline Route
- Proposed Airstrip Access Road
- Proposed Airstrip Extent
- ▨ Proposed Mine Site

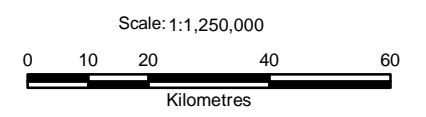
MPB Attack Severity (% of Stand Affected)

MPB Attack Severity

- Severe
- Moderate
- Low
- Fire Extent - 1960 to 2014

Caribou

- Regional Study Area
- Area Used for Habitat Loss and Alteration Analysis
- Caribou Sub-Population Unit



Reference
 BC Government GeoBC Data Distribution
 Caribou Sub-Population Units are shown only for features used in analysis

CLIENT: 		
PROJECT: Blackwater Gold Project		
Cumulative Effects: Caribou Herd Boundary Mtn. Pine Beetle - Severity of Attack		
DATE: September, 2015	ANALYST: MY	Figure 5.4.11-11
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PROJECTION: UTM Zone 10	DATUM: NAD83	

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Table 5.4.11-17: Rationale for Carrying Residual Effects Forward for Caribou

Project Component	Project Phase	Residual Effect	Rationale	Carried Forward in Cumulative Effects Assessment
All	C, O, D/C	Unavoidable loss and alteration of habitat	Decreases from the baseline amount of moderate to high rated suitable habitat available to caribou	Yes
All	C, O, D/C	Unavoidable indirect mortality of caribou	Change in Wildlife Population Dynamics	Yes

Note: C = construction; D/C = decommissioning/closure; O = operations

5.4.11.5.1 Potential Cumulative Effects with other Past, Present, or Future Projects and Activities

The interactions between residual effects on caribou related to the Project and those related to past, present, and foreseeable projects and potential ecological effects are summarized below. Pre-existing habitat loss and fragmentation due to logging and road development have altered the low elevation habitat within the Project area. The MPB infestation has affected large areas of mature pine forest in the region, which has resulted in, and will result in future loss of caribou habitat (Hebert 2014). Some MPB-killed pine forest was harvested while remaining forests are in various stages of degeneration due to the MPB. Mineral exploration in the area has increased the number of access roads, increasing habitat fragmentation and road access for predators. There is no hunting season in the Project area; however, the area is used by recreationalists who may impact caribou by disturbance and displacement. There is traditional use for caribou which is described in **Section 5.4.11.2.2**. Caribou baseline information was collected in the LSA and portions of the RSA that were altered by these past and present activities. Current land and resource activities in the Project area are expected to continue in the future.

Forest fire and forest insects are the primary natural disturbances in low elevation winter ranges of the Itcha-Ilgachuz and Tweedsmuir-Entiako caribou subpopulations. Fire directly alters habitat through loss of mature conifer stands, lichens, and other forage plants and may create barriers to movement. Indirectly, fire transforms mature and old forests into early seral habitat favoured by moose and deer, resulting in increased wolf densities and potentially increased caribou mortality risk. Historically, following a wildfire, caribou would shift their use of habitat from affected areas to more suitable areas (Cichowski, 2010). Barrier effects to this movement pattern depend on intensity of the burn and the size of the fire. Caribou have evolved in a fire-driven landscape and will use burns depending on amount of unburned patch retention and will readily cross small burns. Fire is a natural mechanism for habitat renewal, but the important consideration is the cumulative creation of early seral habitats by fire disturbance where it interacts with significant amounts of human disturbance to a level that affects predator-prey dynamics (Environment Canada, 2014). Browse-rich early seral habitats are attractive to other ungulate species and their associated predators, which can result in increased predation risk to caribou depending on numerical response of predators to the prey base. With the increase of industrial and agricultural activities,

there are fewer suitable areas of caribou habitat. Disturbance threshold analysis by Environment Canada (2014) concluded that anthropogenic disturbance had a greater effect than natural disturbance on probability of persistence at the caribou population range scale.

MPB has affected most low elevation winter ranges in the Project area and may affect caribou through the loss of terrestrial and arboreal lichen habitat, as other species replace lichens after the death of pines. Although initially dwarf shrub abundance increased and terrestrial lichen abundance declined following MPB infestation (Cichowski et al., 2008; Cichowski et al., 2009; Seip and Jones, 2010; Waterhouse, 2011), abundance of dwarf shrubs has since declined and terrestrial lichen abundance has increased slightly.

Habitat fragmentation and linear density of roads likely contribute to baseline conditions of reduced caribou habitat suitability in the Project area as do changes in wildlife population dynamics that may result in increased predation rates on caribou (Hebblewhite et al., 2010; Apps et al. 2013; Steenweg, 2011; Whittington et al., 2011; Williamson-Ehlers, 2012; Williamson-Ehlers et al., 2013). The presence of significant areas of provincial parks and special RMZs reduces the potential for significant cumulative effects due to linear developments and industrial activity in the subpopulation areas.

Many of the threats to caribou and caribou habitat are related to each other and may interact. Cumulative effects may not be evident when threats are examined individually. According to the Caribou Recovery Strategy (Environment Canada, 2014), mining is considered to have low impact, small scope, and slight severity when assessed for the northern group of the Southern Mountain caribou population (which includes the subpopulations close to the Project) compared to effects from other developments such as forestry and agriculture.

Table 5.4.11-19 includes the effects of forestry activities, transportation and access, mining activities, trapping and guide outfitting, traditional land use, recreational activities, and other projects, as well as the effects of disease, MPB, and fire on caribou habitat.

Some of these anthropogenic disturbances are quantified and include mining activity (quarries and prospecting), forestry (cutblocks and woodlots), and forestry roads. The RSA comprises 291,714 ha, of which 90,177 ha interacts with anthropogenic disturbances, and 160,462 ha interacts with natural disturbances (**Table 5.4.11-22**).

An overlap of the activities is included in **Table 5.4.11-22** with the habitat rated moderate to high for caribou (spring, summer/fall, and winter) (**Table 5.4.11-23**). Wildfires have impacted 19,337 ha (7%) of the RSA, 328 ha (3%) of the LSA and 146,608 ha (11%) of the Tweedsmuir subpopulation range and 66,248 ha (7%) of the Itcha Ilgachuz subpopulation range. MPB has impacted over 60% of moderate to high rated suitable caribou habitat in the RSA.

The named projects from the project inclusion list in **Table 4.3-11** that represent present and future projects will not have interactions with the Project however the listed activities from the list will. Pre-existing habitat loss and fragmentation due to logging and road development has altered the higher suitability low elevation habitat within the Project area (see **Table 5.4.11-18**). The mountain pine beetle has infested large areas of mature pine forest in the region including the LSA and RSA,

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some of which was harvested while remaining forests are in various stages of regeneration. Logging and mineral exploration in the area increased the number of access roads. Caribou baseline information was collected in the study areas that have been altered by these past and present activities. Wildfire in 2014 has recently altered large portions of the MPB infested areas of the Tweedsmuir subpopulation and reduced overall suitable habitat. The future activities in the RSA are expected to include similar activities. With the increase of industrial and agricultural activities, loss of effective habitat may result in less suitable areas for caribou. Hebert (2014) has identified MPB related impacts to caribou as a key factor affecting between 53% and 60% of suitable habitat stands in map areas (Map Sheet 93F and 93C) where caribou occur, which is comparable to this cumulative effects analysis of impacts to moderate to high rated suitable caribou habitat in the RSA (>60% for different seasons).

Table 5.4.11-18: Potential Adverse Effects Resulting from Past, Present and Future Projects and Activities

Project/Land Use	Description/Status	Location relative to Blackwater Project	Timing Relative to Blackwater Project	Potential Adverse Effect to caribou and Caribou Habitat
Mining – exploration	Two developed prospects, exploration programs, and numerous mineral claims and tenures; includes several New Gold mining exploration projects, such as Van Tine, Capoose, Fawnie, Emma, and Auro.	In LSA and RSA	Ongoing	Alteration or destruction of terrestrial habitats due to exploration activities.
Forestry – logging	Various historical, active, and pending logging tenures and woodlot licenses; private forest lands.	In LSA and RSA	Ongoing	Alteration or destruction of terrestrial habitats and due to forest harvesting and silviculture activities.
Agriculture	69 active range tenures within the RSA.	Location relative to Blackwater Project	Timing Relative to Blackwater Project	Alteration to vegetation communities due to livestock activities including introduction of invasive plants. Compaction of soil due to livestock.
Transportation	Traffic associated with recreation and other activities along the Kluskus FSR. Several airports, airstrips, and aerodromes for fixed wing and seaplanes.	Intersects transmission line LSA	Future	Alteration of suitable habitat. Direct road mortality and indirect displacement from suitable habitat near roads. Increased predator access and efficiency.

5.4.11.5.1.1 *Residual Cumulative Effects and Mitigation Measures*

Forestry-related activities in the Project area will degrade and remove moderate to high value caribou habitat for all seasons. The primary measures to mitigate the impacts of forestry-related activities will include:

- Following forest harvest guidelines, including cutblock and road design to minimize direct mortality of caribou and creation of habitat that may augment alternate prey and predators in proximity to caribou range;
- Minimizing soil erosion and maximizing reforestation to reduce the time required for re-establishment of terrestrial and arboreal lichens; and
- Implementing invasive plant control measures and monitoring systems to reduce attractants to alternate prey and potential competition that might inhibit lichen re-establishment.

Given the adherence to these measures, the loss of baseline ecosystem composition is expected to be low after revegetation, and recovery of the affected sites to baseline state is predicted to occur post-closure.

Broad regional collaborative measures may include:

- Maximizing reforestation particularly in MPB-impacted and wildfire areas to reduce the time required for re-establishment of terrestrial and arboreal lichens;
- Restricting snowmobiling in high elevation habitat within ranges of Tweedsmuir and Itcha-Ilgachuz subpopulation ranges to reduce disturbance of caribou and access to caribou by predators using trails;
- Avoiding the setting of early season ski tracks that lead into caribou winter range, including periodic seasonal trail and road closures in important calving or wintering range to reduce disturbance of caribou and access to caribou by predators using trails;
- Developing and implementing operating guidelines for industrial development within caribou ranges to reduce potential displacement and mortality;
- Land use planning to identify areas within caribou ranges where caribou conservation is prioritized;
- Implementing hunting closures and restrictions in areas that remain open to hunting;
- Reducing speed zones on road sections in important caribou habitat;
- Assisting in predator and alternate prey management projects where caribou are declining or showing unsustainable calf/adult mortality;
- Developing cooperative stewardship agreements, memoranda of understanding, and activities to support the engagement of Aboriginal organizations, recreational

stakeholders, and other stakeholders in the monitoring, management, and conservation of caribou, including predator management;

- Preparing and providing outreach materials relating to caribou and distribution to mine staff and contractors and other interest groups, recreational organizations, and the general public, including education on how to avoid disturbing caribou; and
- Supporting ongoing research relating to caribou habitat, ecology, and limiting factors.

Overlaps of forestry, mining, roads, fire, and MPB infestation on moderate to high value caribou habitat are summarized in **Table 5.4.11-24** to **Table 5.4.11-26**.

Prior to mine operation, the Proponent will define its contribution to regional management initiatives for ongoing research and monitoring of the Tweedsmuir-Entiako Northern Caribou subpopulation and their habitat use near the mine. Progress will be reported at least every three years through the operation of the mine in implementing the Proponent's contribution to regional initiatives and how the initiatives have influenced mine activities, undertakings, or works to the BC MOE and designated Aboriginal groups.

Table 5.4.11-19: Key and Moderate Interactions between Caribou Residual Effects and other Past, Present, and Future Projects/Activities

Project Phase	Potential Effect	Historical Land Use				Representative Current and Future Land Use and Ecological Effects								Reasonably Foreseeable Projects		Carried Forward into CEA?
		Recreational (trails, fishing, lodges)	Forestry (cutblocks, woodlots)	Aboriginal Traditional Use	Trapping and Guide Outfitting	Mining (active, current prospecting, quarries)	Recreational (sites, trails, fishing, lodges)	Forestry (cutblocks, woodlots)	Aboriginal Traditional Use	Trapping and Guide Outfitting	Agriculture (present)	Natural Disturbance (fire, MPB, blister rust)	Nulki Hills Wind Project	Agriculture (pending range tenures)		
C, O, CL, PC	Habitat Loss	I	KI	NI	NI	I	NI	KI	NI	NI	NI	KI	NI	NI	Yes	
C, O, CL, PC	Changes to population dynamics, resulting in increased caribou predation by wolves	I	KI	I	I	I	NI	KI	I	NI	NI	KI	NI	NI	Yes	

Note: C = Construction; CEA = cumulative effects assessment; CL = Closure; I = interaction (moderate), KI = key interaction; MPB = mountain pine beetle; NI = no interaction; O = Operations; PC = Post-Closure

Table 5.4.11-20: Assessment of Spatial and Temporal Overlap between the Project and Other Projects and Human and Ecological Actions with Ecosystem Composition

	Human or Natural Activity	Residual Environmental Effect	Extent	Duration	Rationale	Cumulative Effect (Contribution from Project or Overlap)
Historical Land Use	Forestry	Habitat loss and alteration and change in population dynamics, increasing moose and deer habitat	Regional	Chronic	Forestry companies operate within the RSA	Yes
	Recreation	Change in population dynamics (predator access increased)	Regional	Chronic	Trails and other access routes in the RSA	Yes
	Trapping and Guiding	Disturbance and mortality; no hunting season for caribou	Regional	Chronic	Hunters and trappers operate within the RSA	No
	Traditional Use	None	Regional	Chronic	Aboriginal groups are present within the RSA	No
Current and Future Land Use	Forestry	Habitat loss and alteration and change in population dynamics, increasing moose and deer habitat	Regional	Chronic	Forestry companies will continue to pursue logging operations and MPB wood salvage	Yes
	Traditional Use	None	Regional	Chronic	A plan for revegetation is in place	No
	Mining	Habitat loss and alteration and change in population dynamics, increasing moose and deer habitat	Local	Chronic	Mining projects will continue in the RSA	Yes
	Recreation	Disturbance and change in population dynamics, increasing predator access	Regional	Chronic	Recreation will continue in the RSA	Yes

Note: RSA = Regional Study Area

Table 5.4.11-21: Assessment of Spatial and Temporal Overlap between the Project and Interactions with Ecosystem Composition for Caribou

Interaction	Residual Environmental Effect	Extent	Duration	Rationale	Cumulative Effect (Contribution From Project or Overlap)
Trapping and Guiding	Disturbance and mortality; limited impact to caribou	Regional	Chronic	Hunters and trappers operate within the RSA and may kill caribou	Yes
Mountain Pine Beetle	Habitat loss and alteration and change in population dynamics, increasing moose and deer habitats	Regional	Chronic	Infestation reduces the number of healthy trees that provide food, security, and thermal cover	Yes
Fire	Habitat loss and alteration and change in population dynamics, increasing moose and deer habitats	Regional	Chronic	Fire will remove potential feeding and security habitat	Yes

Note: RSA = Regional Study Area

Table 5.4.11-22: Spatial Overlap of Caribou RSA by Source of Habitat Loss

Disturbance	Spatial Overlap with RSA	Temporal Overlap with RSA	Amount of Overlap (ha)
Nulki Hills Wind Project	No	No	n/a
Mining Activity	Yes	Yes	309
Forestry (cutblocks and woodlots) – past, present, and future	Yes	Yes	69,625
Forestry Roads	Yes	Yes	2,111
Fire	Yes	Yes	19,337
Mountain Pine Beetle ⁽²⁾	Yes	Yes	136,910
Total			217,053⁽¹⁾

Note: ha = hectare; RSA = Regional Study Area
⁽¹⁾ The total does not equal the sum of the projects because of overlap
⁽²⁾ Mountain Pine Beetle infestations of ≥ 10%

Table 5.4.11-23: Cumulative Effects – Spatial Overlap of Disturbance on Caribou Habitat by Rating Class in LSA and RSA

	Spring Habitat Area (ha)			Summer/Fall Habitat Area (ha)			Winter Habitat Area (ha)		
	High	Moderate High	Moderate	High	Moderate High	Moderate	High	Moderate High	Moderate
LSA									
Cutblocks	2	16	89	1	16	573	26	67	150
Airfields	0	0	0	0	0	0	0	0	0
Mining	11	17	49	4	17	57	11	17	53
Roads - Footprint	0	1	5	0	0	7	0	10	26
Roads - 50 m	1	22	43	0	4	90	2	36	83
Roads - 100 m	28	46	283	1	38	548	35	75	337
Roads - 500 m	188	233	1,531	14	252	2,568	217	311	1,816
Fire	5	1	3	1	1	45	21	1	28
Total LSA	518	785	3,535	160	833	5,343	563	867	4,071
RSA									
Cutblocks	27	3,068	12,481	1	3,071	14,874	65	4,485	13,057
Airfields	0	0	3	0	0	3	0	13	1
Mining	12	39	110	4	39	123	12	31	124
Roads - Footprint	0	9	37	0	0	49	0	18	101
Roads - 50 m	3	79	366	0	16	492	4	105	675
Roads - 100 m	68	373	2,215	1	325	3,170	75	645	2,471
Roads - 500 m	437	3,641	18,591	14	3,637	24,326	476	5,907	18,890
Fire	76	63	1,290	1	63	1,674	106	408	1,079
Total RSA	1,252	18,056	77,131	171	18,280	86,331	1,323	27,406	71,654

Note: ha = hectare; LSA = Local Study Area; m = metre; RSA = Regional Study Area;
 Effects are not measured relative to the LSA but are provided as a context for RSA assessment. Fires including those in 2014 have impacted a total of 146,608 ha within the Tweedsmuir caribou subpopulation range and 66,248 ha within the Itcha Ilgachuz caribou subpopulation range, including a total of 19,337 ha in the RSA.

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Table 5.4.11-24: Cumulative Effects – Spatial Overlap of Disturbance with Caribou Spring Season Habitat

Project	Spatial Overlap with High to Moderate Rated Habitat	Temporal Overlap with High to Moderate Rated Habitat	Amount of Overlap with Moderate to High in LSA (ha)	Total High to Moderate Rated Habitat in LSA (ha)	Amount of Overlap with High to Moderate in LSA (%)	Spatial Overlap with High to Moderate Rated Habitat	Temporal Overlap with High to Moderate Rated Habitat	Amount of Overlap with Moderate to High in RSA (ha)	Total High to Moderate Rated Habitat in RSA (ha)	Amount of Overlap with High to Moderate in RSA (%)
Nulki Hills Wind Project	No	No	0	4,838	0.0%	No	No	0	96,439	0.0%
Mining Activity	Yes	Yes	77	4,838	1.6%	Yes	Yes	160	96,439	less than 1.0%
Forestry (cutblocks and woodlots) past, present, and future	Yes	Yes	107	4,838	2.2%	Yes	Yes	15,369	96,439	15.9%
Forestry Roads - 50 m	Yes	Yes	66	4,838	1.4%	Yes	Yes	447	96,439	less than 1.0%
Forestry Roads - 100 m	Yes	Yes	357	4,838	7.4%	Yes	Yes	2,656	96,439	2.8%
Fire	Yes	Yes	9	4,838	less than 1.0%	Yes	Yes	1,430	96,439	1.5%
Mountain Pine Beetle	Yes	Yes	3,567	4,838	73.7%	Yes	Yes	58,522	96,439	60.7%

Note: ha = hectare; LSA = Local Study Area; m = metre; RSA = Regional Study Area; % = percentage

Table 5.4.11-25: Cumulative Effects – Spatial Overlap of Disturbance with Caribou Summer/Fall Season Habitat

Project	Spatial Overlap with High to Moderate Rated Habitat	Temporal Overlap with High to Moderate Rated Habitat	Amount of Overlap with Moderate to High in LSA (ha)	Total High to Moderate Rated Habitat in LSA (ha)	Amount of Overlap with High to Moderate in LSA (%)	Spatial Overlap with High to Moderate Rated Habitat	Temporal Overlap with High to Moderate Rated Habitat	Amount of Overlap with Moderate to High in RSA (ha)	Total High to Moderate Rated Habitat in RSA (ha)	Amount of Overlap with High to Moderate in RSA (%)
Nulki Hills Wind Project	No	No	0	6,336	0.0%	No	No	0	104,781	0.0%
Mining Activity	Yes	Yes	78	6,336	1.2%	Yes	Yes	166	104,781	less than 1.0%
Forestry (cutblocks and woodlots) past, present, and future	Yes	No	590	6,336	9.3%	Yes	Yes	17,945	104,781	17.1%
Forestry Roads - 50 m	Yes	Yes	94	6,336	1.5%	Yes	Yes	508	104,781	less than 1.0%
Forestry Roads - 100 m	Yes	Yes	588	6,336	9.3%	Yes	Yes	3,496	104,781	3.4%
Fire	Yes	Yes	47	6,336	less than 1.0%	Yes	Yes	1,738	104,781	1.7%
Mountain Pine Beetle	Yes	Yes	4588	6,336	72.4%	Yes	Yes	65,928	104,781	62.9%

Note: ha = hectare; LSA = Local Study Area; m = metre; RSA = Regional Study Area; % = percentage

Table 5.4.11-26: Cumulative Effects – Spatial Overlap of Disturbance with Caribou Winter Season Habitat

Project	Spatial Overlap with High to Moderate Rated Habitat	Temporal Overlap with High to Moderate Rated Habitat	Amount of Overlap with Moderate to High in LSA (ha)	Total High to Moderate Rated Habitat in LSA (ha)	Amount of Overlap with High to Moderate in LSA (%)	Spatial Overlap with High to Moderate Rated Habitat	Temporal Overlap with High to Moderate Rated Habitat	Amount of Overlap with Moderate to High in RSA (ha)	Total High to Moderate Rated Habitat in RSA (ha)	Amount of Overlap with High to Moderate in RSA (%)
Nulki Hills Wind Project	No	No	0	5,502	0.0%	No	No	0	100,383	0.0%
Mining Activity	Yes	Yes	81	5,502	1.5%	Yes	Yes	166	100,383	less than 1.0%
Forestry (cutblocks and woodlots) past, present, and future	Yes	No	244	5,502	4.4%	Yes	Yes	17,607	100,383	17.5%
Forestry Roads - 50 m	Yes	Yes	120	5,502	2.2%	Yes	Yes	784	100,383	less than 1.0%
Forestry Roads - 100 m	Yes	Yes	447	5,502	8.1%	Yes	Yes	3,191	100,383	3.2%
Fire	Yes	Yes	49	5,502	less than 1.0%	Yes	Yes	1,592	100,383	1.6%
Mountain Pine Beetle	Yes	Yes	4,109	5,502	74.7%	Yes	Yes	61,511	100,383	61.3%

Note: ha = hectare; LSA = Local Study Area; m = metre; RSA = Regional Study Area; % = percentage

5.4.11.5.2 Assessment of Caribou Habitat Loss and Change in Population Dynamics

Based on the CEA of potential effects on caribou, MPB infestation and forestry activities are currently impacting the caribou subpopulation areas (**Table 5.4.11-27**). Project contribution to cumulative habitat loss is less than 1% of the CEA loss before reclamation.

The Tweedsmuir-Entiako subpopulation is currently considered at the minimum subpopulation size to be viable with an estimated population of 300 caribou; however, with the calf recruitment indicated as low (less than 1.0 per 100 cows), the subpopulation is considered to be in decline and to be at high risk (not self-sustaining) if the trend continues. The Itcha-Ilgachuz subpopulation is considered viable with an estimated population of 1,700 (Environment Canada, 2014). The declining health of pine forests within the LSA and RSA due to the outbreak and spread of MPB and forestry-related activities has degraded moderate and high value caribou habitat, and this alteration is expected to continue regardless of the Project. Forest fire has affected 2.5% (328 ha) of the LSA and 3.0% (8,098 ha) of the RSA and has the potential to affect caribou habitat in the future. The greatest impact is habitat alteration related to MPB (**Figure 5.4.11-10**) affecting 61% (7,994 ha) of the LSA and 53% (136,910 ha) of the RSA. With respect to the subpopulation areas, 39% (443,509 ha) of the Tweedsmuir-Entiako subpopulation and 69% (654,621 ha) of the Itcha-Ilgachuz subpopulation are effected by MPB infestation. The areas affected by MPB are expected to have reduced caribou habitat value, but some studies suggest that habitat value may be maintained depending on lichen persistence (Cichowski et al., 2008), so the percentage area affected by MPB does not equate to total habitat loss for caribou. Wildfire (including in 2014) has impacted 11% of the Tweedsmuir subpopulation range and 7% of the Itcha-Ilgachuz subpopulation range (within the area affected by MPB).

Based on assessment of forestry stand data for remaining non-pine conifer forests in the subpopulation areas (**Figure 5.4.11-10**), the Tweedsmuir-Entiako subpopulation will have 29% (388,171 ha) of non-pine conifer forests and the Itcha-Ilgachuz subpopulation will have 8% (73,924 ha) of non-pine conifer forest remaining if all mature pine forests die after MPB infestation. These cumulative effects are expected to impact habitat supply for both caribou subpopulations, particularly in the Itcha-Ilgachuz subpopulation with 69% to 92% of the habitat area affected by MPB. The Tweedsmuir-Entiako subpopulation potentially has a 29% habitat loss but remains below the Environment Canada (2014) cumulative threshold of 35% and the Project contribution to the total is less than 1%. Additional habitat mitigation through enhanced reforestation of MPB areas will mitigate the habitat loss in the far future. Project effects make minor contributions to these cumulative effects which are created mainly by logging and MPB. Project mitigation measures will reduce the potential cumulative effects due to MPB and forestry in the Project LSA. Project mitigation includes research and reforestation of whitebark pine ecosystems as per the Whitebark Pine Management Plan.

Project effects make a Not Significant (minor) contribution to wolf densities that may increase predation of caribou. Collaborative mitigation measures, including long-term habitat management to reduce early seral habitat and wildlife management initiatives to reduce caribou mortality, can mitigate cumulative impacts to regional changes in population dynamics.

Hebert (2014) included the following assessment of habitat supply for areas affecting the 2 subpopulations in **Table 5.4.11-28** Hebert (2014) has similar cumulative effects conclusions for the caribou subpopulations.

Table 5.4.11-27: Summary of Potential Cumulative Effects from Fire and Mountain Pine Beetle

Subpopulation		Loss of LSA Habitat	Loss of RSA Habitat	Loss of Herd Area
Tweedsmuir-Entiako	Fire	2.5% (328 ha)	7.5% (19,337 ha)	10.9% (146,608 ha)
	MPB	61% (7,994 ha)	53% (136,910 ha)	39% (443,509 ha)
	Remaining non-pine conifer stands	-	-	29% (388,171 ha)
Itcha-Ilgachuz	Fire	-	-	7% (66,248 ha)
	MPB	-	-	69% (654,621 ha)
	Remaining non-pine conifer stands	-	-	8% (73,924 ha)

Note: ha = hectare; LSA = Local Study Area; MPB = mountain pine beetle; N/A = not applicable; % = percent
 RSA = Regional Study Area

Table 5.4.11-28: Habitat Supply Analysis (Hebert, 2014)

Designation	Map Sheet 93F	Map Sheet 93C	Total
Base area of map sheet - ha	1,476,585	1,510,878	
Non-vegetated component - ha	122,247	168,759	
Net land base 1 - ha	1,354,338	1,342,119	
pl survival - ha	222,605	419,419	
sp survival - ha	278,055	106,462	
Total Survival - ha	500,660	525,881	
Percent survival 1	37%	39%	
By species pl	16%	31%	
By species sp	21%	8%	
Total			
Young age class			
< 50 yr pl (ha)	200,443	17,044	217,487
< 30 yr sp (ha)	78,116	802	78,918
Total young (ha)	278,559	17,846	
Percent occurrence			
By species pl	15%	1%	
By species sp	6%	<1%	
Net land base (remove young age class) (ha)	1,075,779	1,324,273	
Percent survival 2	47%	40%	

5.4.11.5.2.1 Significance of Residual Cumulative Effects in the RSA

The residual cumulative effects on caribou are summarized in **Table 5.4.11-29**, shown with and without Project contribution. Residual cumulative effects without the Project are considered negative with permanent loss of habitat and impacts to population dynamics. Residual cumulative effects currently affects 29% of the RSA, including effects of the two greatest contributors—forestry and MPB. This level of disturbance is lower than the potential 35% threshold identified by Environment Canada (2014). However, due to the large area affected by MPB, there is a reasonable likelihood that future cumulative impacts to caribou habitat could increase beyond the 35% threshold even in the absence of project residual effects. Within the habitat loss and alteration RSA, the Project contribution to potential cumulative habitat loss of moderate to high value habitat is far less than 1% of this total, which is well below the 20% threshold for Project-related disturbance. The Environment Canada (2014) threshold of 35% disturbed area within the subpopulation critical and matrix habitat is currently not exceeded; therefore, the habitat loss and alteration in the CEA related to the project is considered Not Significant (moderate).

Table 5.4.11-29: Post-Closure Residual Cumulative Effects Assessment on Caribou

Effect Attribute	Current/Future Cumulative Environmental Effect(s) without Project	Cumulative Environmental Effect with Project Contributions
Context	High	High
Magnitude	High	High
Geographic Extent	Regional	Regional
Duration	Chronic	Chronic
Reversibility	Yes	Yes
Frequency	Continuous	Continuous
Likelihood Determination	Moderate	Moderate
Level of Confidence for Likelihood	High	High
Significance Determination	Not Significant (moderate)	Not Significant (moderate)
Level of Confidence for Significance	Moderate	Moderate

Caribou calf surveys of both subpopulations (Cichowski, 2010; Cichowski, 2013) suggest that predation levels currently indicate wolf densities may be greater than 3 per 1,000 km², which would exceed the threshold for significance related to changes in caribou population dynamics (Environment Canada, 2014). Changes to wolf density is a landscape level effect and provincial data on wolf numbers and distribution is limited. Although the calf mortality rates suggest that predation was high in 2013 in the Tweedsmuir-Entiako subpopulation area (Hebert, 2013, pers. comm.), Project contributions are considered to be insignificant to minor because the Project is unlikely to result in changes to moose populations. Mitigation measures include planting species that won't enhance alternate prey such as moose in the Project area. Therefore, the Project is not anticipated to alter predator/prey dynamics Project contribution to caribou population dynamics is considered to be Not Significant (minor) for the RSA.

5.4.11.6 Limitations

The key limitation of this assessment is the unavailability of data to represent the level of habitat loss and degradation for the two subpopulations related to forestry activities and MPB infestations within the Caribou RSA. Terrestrial Ecosystem Mapping (TEM) or Predictive Ecosystem Mapping (PEM) formed the basis for habitat polygons rated in the LSA and portions of the RSA. Habitat data were not available for the caribou subpopulation areas; however, road density and cumulative impacts from MPB infestation, forestry, and fires on an area basis for the subpopulations were assessed as a qualitative measure of mortality risk, changes to wildlife population dynamics, and habitat loss and alteration. Despite these limitations, predictions of low Project effects are made with high confidence.

5.4.11.7 Conclusion

Caribou habitats will be adversely affected through loss and degradation during the lifetime of the Project but have a high probability to return to near baseline conditions upon post-closure, when silvicultural practices such as conifer planting and discouraging deciduous growth can accelerate site recovery. Loss and degradation effects from clearing of vegetation and increased predation result in a Not Significant residual effect on caribou during the life of the Project.

The potential Project residual effects include habitat loss and degradation of moderate to high value habitat for caribou. These effects will be primarily caused by mine site development. The maximum extent of these effects is local in context, with the loss pertaining to the clearing limits and degradation within 50 m of those limits, and a risk of displacement within 500 m of the cleared areas.

Mitigation and adaptive management plans will avoid and mitigate Project effects. Where it is not possible to mitigate completely, the effects will be minimized to keep the magnitude of effects at a low level.

Mortality and sensory impact effects on caribou were not significant, primarily because of the limited extent and low magnitude of Project activity that overlaps baseline caribou habitat used in recent history. The mitigation measures for minimizing residual effects on caribou are captured in the WLMP presented in **Section 12.2.1.18.4.6**.