APPENDIX 13

Wildlife Habitat Suitability Modeling – Data Report

Victoria GOLD CORP

Stantec

EAGLE GOLD PROJECT

Wildlife Habitat Suitability Modeling

DATA REPORT

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1 WILDLIFE HABITAT SUITABILITY MODELING

1.1 Introduction

Habitat suitability modeling was completed for grizzly bear and moose, to support the Project Proposal assessment of potential Project effects on these two species. Moose and grizzly bear were the focus of habitat modeling due to:

- Strong baseline understandings of habitat use by moose and grizzly bear during critical times of the year facilitating survival
- Moose is the most abundant, large hunted mammal, within the LAA and of particular importance to FNNND
- Grizzly bear, utilize many habitat types that are also used by many other species across large areas.

Habitat requirements, key life requisites, and the modeling results for the two species are presented in this report. Changes in the areas of special interest (wetlands, riparian areas, and old forest) were used to assess Project effects on other species that depend on these habitats, including American marten, Olive-sided Flycatcher and Rusty Blackbird, See Section 6.8, Vegetation for additional information on habitat ratings.

1.2 Habitat Ratings

Wildlife habitat suitability modeling uses habitat ratings as a method of assessing the amount and quality of available habitat for selected wildlife species. Habitat ratings are developed with consideration to the status, ecology, habitat requirements, use, and ecosystem attributes required by the selected wildlife species.

Each wildlife model is supported by a vegetation map prepared for the entire Local Assessment Area, which contains the Project's mine site and access road. The wildlife LAA (which is equivalent to the Vegetation Regional Assessment Area) encompasses the major habitat types present in the region, and includes the Lynx Creek watershed to the south (which is relatively undisturbed when compared to the majority of the placer-mined drainages in the area) and the South McQuesten River watershed to the north (see Figure 6.9-7 of Project Proposal).

Vegetation mapping provides an inventory of the wildlife habitats found in the LAA. Information on ecosite phases, structural stages (e.g. stand age) and other site modifiers (e.g. canopy cover) is compiled using standard ecological land classification standards (RIC 2002). Table 1 provides a list of all ecosite phases and habitat types that were rated for wildlife habitat suitability within the LAA and a detailed summary of each is provided in Appendix A.

Table 1: Ecosite Phases found in the LAA

Ecosite Phase Code	Name
AK	Aspen – Kinnikinnick
AW	Alaska birch – White spruce – Willow
BL	Dwarf birch – Lichen
BS	Black spruce – Sphagnum
CF	Sedge Fen
CL	Cliff
ES	Exposed Soil
FC	Subalpine fir – Crowberry – Lichens
FF	Subalpine fir – Feathermoss
FM	Subalpine Fir – Labrador Tea
FP	Subalpine Fir – Dwarf birch – Crowberry
GB	Gravel Bar
MA	Marsh
MM	Mountain heather meadow
MW	Mountain avens – Dwarf willows
OW	Open Water
PD	Pond
PH	Balsam poplar – Horsetail
PM	Placer Mine
RI	River
RO	Rock Outcrop
RZ	Road
SA	Dwarf birch – Northern rough fescue (tall shrub)
SC	Black spruce – Cladina
SF	White spruce – Feathermoss
SH	White spruce – Horsetail
SL	Black spruce – Labrador tea – Feathermoss
TA	Talus
WG	Willow – Groundsel
WH	Willow – Horsetail
WM	Willow – Mountain sagewort
WS	Willow – Sedge wetland

To build the models, a wildlife habitat suitability rating is assigned for each ecosystem unit (i.e., each ecosite phase/structural stage combination) occurring in the LAA. Because each wildlife species has different habitat requirements, each model requires a separate habitat suitability rating for each ecosystem unit. Other parameters were integrated into the ratings, as appropriate, to reflect species' habitat requirements. These parameters include moisture regime, shrub cover, canopy cover, minimum habitat patch size, and the distribution of resources (for food, shelter and reproduction) that together fulfill a species' habitat needs. Table 2 provides definitions for each structural stage.

Table 2: Structural Stage Descriptions

Symbol	Structural Stage	Age Criteria and Description
1	Sparse/Bryoid	Initial stages of primary and secondary succession; total shrub and herb cover is less than 20%
1a	Sparse	Less than 10% vegetation cover. (Less than 20 years.)
1b	Bryoid	Bryophyte and lichen-dominated communities; >1/2 total vegetation cover (less than 20 years)
2	Herb	Early successional stages, and disclimax or climax sites, dominated by herbaceous vegetation (tree cover < 10%, shrub cover <= 20%, herb cover >20% or >= 33% of total cover) (less than 20 years for normal forest succession)
2a	Forb-dominated	Herbaceous communities dominated (>1/2 of total herb cover) by non-graminoid herbs, including ferns
2b	Graminoid-dominated	Herbaceous communities dominated (>1/2 of total herb cover by graminoids [grasses, sedges, reeds, and rushes])
2d	Dwarf woody shrub dominated	Herbaceous communities dominated [>1/2 of total herb cover by dwarf woody species (mountain-heathers, mountain avens, dwarf willows)]
3	Shrub/Herb	Early successional stages, and communities dominated by shrub vegetation <5m in height (tree cover <10%, shrub cover >20% or > = 33% of total cover). Used for communities that will be forested at climax (less than 20 years for normal forest succession)
3a	Low Shrub	Disclimax or climax communities dominated by shrub cover <2 m in height.
3b	Tall Shrub	Disclimax or climax communities dominated by shrub cover 2 – 5 m in height.
5	Young Forest	Self-thinning is usually evident and the forest canopy has begun differentiation into distinct layers (40 – 80 years).
6	Mature Forest	Trees established after the last disturbance have matured and a second cycle of shade tolerant trees may have established. (80 – 140 years for the coniferous stands).
7	Old Forest	Old structurally complex stands. (>140 years for the coniferous stands, >100 years for the deciduous stands).

1.3 Zones of Influence

Final habitat suitability ratings have been developed by consideration of disturbance features (e.g. roads, Project facilities, and infrastructure) and include items associated with land use activities that are present under baseline conditions as well as those associated with the construction and operations of the Project. A zone of influence (ZOI) is assigned to each disturbance feature and each species modeled.

Wildlife responds differently to various anthropogenic disturbances. Roads, associated traffic and machines, as well as infrastructure (facilities, camps, mine sites) all produce sensory disturbance (primarily in the form of sound/noise levels) that have potential negative effects on local wildlife in the form of habitat avoidance/aversion. It is important to note that the degree to which sensory disturbance associated with human activities may affect wildlife is influenced by a variety of factors (e.g. species, time of day, age and sex class, habitat type, topography, degree of habituation), and consequently is difficult to predict, but is most likely to be manifested as avoidance or underutilization of habitats within a certain distance of a disturbance.

ZOIs can be used to model an estimated response from a given wildlife species to a specific disturbance type. A ZOI is the zone (beyond the actual footprint of the disturbance feature) over which the effects of the disturbance feature (e.g. road, mine) are presumed to result in the loss or alteration of available habitat due to displacement, or decreased use or less effective use. To model this indirect effect, habitat suitability ratings (i.e., quality) within sensory disturbance buffers were adjusted based on the nature of the disturbance feature. The widths of the sensory disturbance buffers depend on a species' known or presumed sensitivity to the type of activity under consideration, and are based on existing literature (which reports a variety of figures) and professional judgment (AXYS 2001).

In relatively pristine areas, with little in the way of development, an introduced disturbance element, or increase in intensity of an existing disturbance, may have more of an effect as species are not accustomed to the disturbance intensity/regime. The opposite holds for areas where the cumulative level of existing disturbance is relatively high and local wildlife have become somewhat habituated.

Professional judgment and baseline data collected within the LAA also provide justification for a ZOI. For example, track and scat data may indicate extensive use of an existing road and habitat areas directly adjacent to the road, indicating that at baseline conditions the road is exerting little influence on species behavior. If traffic levels are expected to increase significantly over baseline conditions, a ZOI can be considered as local wildlife respond accordingly to heightened disturbance levels. As example, moose may now find that feeding within 50m of the roadway is not preferred as traffic volume/ noise increases.

1.4 Disturbance Coefficients

Disturbance coefficients (DC) are applied to habitat units that are influenced by adjacent anthropomorphic features (i.e., fall within a ZOI). The DC is an index value applied to habitat ratings as a measure of the effect of the disturbance. For example, when a disturbance feature creates a negative effect, the disturbance coefficient is subtracted from the habitat rating for the ecosite area that falls within the

ZOI. The DC is based on guidelines in the Resource Inventory Committee Standards (1999). DCs are paired with ZOI data to model habitat suitability for wildlife. Coefficient values reflect species differences in sensitivity to disturbance features. As such, ZOIs and DCs are evaluated separately for each species and are discussed in individual species accounts.

1.5 Species Accounts

1.5.1 Grizzly Bear

Name: *Ursus arctos horribilis*

Species Code: M-URAR

Status: No conservation status under SARA however designated as a species of Special Concern by COSEWIC in 2002.

Distribution

Territorial Range:

Grizzly bears are distributed throughout the entire Yukon however bear densities are comparatively lower than populations in southern or coastal environments due to inhabiting a less productive environment.

Territorial Context:

The grizzly bear population is estimated between 6,000 and 7,000 individuals in the Yukon.

Project Area: Mayo

Ecozone: Boreal Cordillera

Ecoregion: Yukon Plateau-North

Biogeolimatic Zones: Subalpine and Forested Zones

Ecology and Key Habitat Requirements

Grizzly bears have large home ranges that occasionally overlap. While grizzly bears are generally not considered to be territorial, individuals appear to maintain distance between themselves and other bears (Servheen 1993). The home range of a male grizzly bear is approximately two to four times larger than that of a female. The range of a female bear with cubs is, on average, smaller than that of a female without cubs as it is restricted by the mobility of the offspring. The home range size for grizzly bears is influenced by food availability, weather conditions, and interactions with other bears. Home range sizes for grizzly bears in the Yukon are estimated at 1,682 km² for males and 491 km² for females (YFWCM 1997).

Grizzly bears generally inhabit dense shrub land or forest but will occasionally make use of natural or human made clearings and open areas. Servheen (1993) suggests that forest cover in proximity to forage areas may be an important feature for grizzly bears for bed use, security, thermoregulation,

and foraging. Suitable grizzly habitat is characterized by availability of large trees as possible den sites, seasonal foraging routes such as watershed corridors and ungulate ranges, and forest pathways which provide secure migration routes.

Habitat Use – Life Requisites and Season of Use

Feeding

Grizzly bears are mostly solitary omnivores which require access to diverse habitats to meet their ecological needs. A grizzly bear's choice of habitat is primarily based on availability of forage during the growing season (Gyug, et al., 2004). Grizzly bear habitat during the growing season can include coniferous forests, subalpine willow belts, and open alpine meadows. Grizzly bears forage on a wide variety of foods including young plants, grasses, forbs, berries, fish, birds, mammals, and carrion with notable changes based on seasonal availability for their region. Grizzly bears will move seasonally to follow adequate or quality food sources. Following emergence from dens in the spring, grizzly bears forage in the subalpine zone, feeding on over-wintered berries, marmots, and ground squirrels. Riparian areas provide access to early growing Eskimo potatoes and horsetails (Environment Yukon 2009). Late spring and early summer provide greater foraging accessibility at higher elevations. Grizzly bears are likely to occupy a wider range of habitats throughout the summer due to abundance of food availability. Foraging in summer months is mostly on alpine grasses, but bears will migrate to river flats in mid-July to feed on ripening soapberries. Fall feeding escalates as bears try to develop fat stores to sustain themselves through winter denning. Berries, ground squirrels, and salmon runs (when accessible) are the main sources of food for this time of year.

Hibernation/Denning

Hibernation is triggered by the unavailability of suitable foods, deep snow, and low ambient air temperatures, in addition to decreasing day length and onset of inclement weather (Servheen 1993). Grizzly bears will den for approximately five to seven months of the year (Fuhr and Demarchi 1990). Preferred den locations are found on south-facing slopes near the tree line, preferably away from potential human disturbances. A den is excavated out of a hill slope in late fall and is lined with grasses, moss, and twigs for increased insulation (Environment Yukon 2009).

Reproduction

The majority of mating occurs in June in the Yukon, coinciding with the abundance of food. The rate of grizzly bear reproduction in the Yukon is low compared to more productive grizzly habitat to the south and on the coast. Females reproduce for the first time between 6.5 and 9 years of age, and will produce approximately one or two cubs every three to five years (YFWCM 1997). Cubs are born in February and remain in the den with their mother for a month longer than other grizzlies. Offspring remain with their mothers for two or three years, denning together each winter (Environment Yukon 2009). Cub mortality in the first year is between 25 to 45%. Females do not reproduce again until the current offspring have dispersed.

Security

Grizzly bears may use a combination of cover types as security habitat. Security habitat can include dense vegetation or topography that conceals 90% of a grizzly from the view of a person up to 122 m away (Zager, et al., 1980). Use of habitat for cover may vary between populations that experience different degrees and types of disturbance (e.g. industrial areas, hunting). For example, highly hunted populations may use open habitats to a lesser degree, choosing forested areas which provide improved cover instead. Females with cubs may select isolated and less preferred habitat, such as rugged terrain, to avoid encounters with other bears, particularly male grizzly bears.

Thermal

Thermal habitat is sought by grizzly bears during spring and summer in attempts to reduce body temperature or in search of dry habitat during rain events. Grizzlies will make use of available snow patches earlier in the season to cool down. When snow is no longer available, bears will construct day beds by scraping shallow patches in the earth to access cooler ground conditions. These are typically located close to feeding sites in shady spots adjacent to streams or rivers (Environment Yukon 2009).

Seasons of Use

Grizzly bears require feeding, denning, reproductive, security, and thermal habitat differentially throughout the year. Table 3 summarizes life requisites for grizzly bear during each month of the year.

Table 3: Seasonal life requisites for grizzly bear described by month for the Yukon (*F=Feeding; H=Hibernation/Denning; R=Reproduction; S=Security; T=Thermal*)

Life Requisite	Month	Season
H	January	Winter
H, R	February	Winter
H, R,	March	Winter
F, H, R, S	April	Winter
F, R, S, T	May	Spring
F, R, S, T	June	Spring
F, S, T	July	Summer
F, S, T	August	Summer
F, S, T	September	Fall
F, S, T	October	Fall
F, H	November	Winter
H	December	Winter

Spring and fall have been selected as the most sensitive seasons satisfying life requisite requirements for grizzly bear feeding. These seasons are critical, particularly for reproductive females, which require sufficient food resources during fall prior to entering winter hibernation dens and immediately after den emergence in early spring.

Model Development

For Yukon grizzly bear, a 6-class habitat rating scheme has been selected, based on RIC 1999 and summarized in Table 4.

Table 4: Wildlife Habitat Ratings for Grizzly Bear

Code	Suitability/Quality
1	High
2	Moderately high
3	Moderate
4	Low
5	Very low
6	Nil (habitat not present)

NOTE:

*Habitat ratings are based on the application of the ratings assumptions listed below within individual ground survey plot locations, professional judgement and consideration of the larger landscape context the habitat polygon is located.

Rating Assumptions

A description of habitat rating assumptions are listed below while Table 5 summarizes habitat ratings applied to grizzly bear for spring feeding and fall feeding .

1. The availability and abundance of food items are key factors in habitat selection (Hadden, et al., 1985).
2. Site series can be used to predict forage plant abundance.
3. Ecosystem units with an abundant herb or forb layer consisting of grasses or sedges and species such as Eskimo potato, horsetail, over-wintered cranberries or bearberries, ground squirrels or marmots represent best spring feeding habitat (rich and wet site series generally yield an abundance of these plant species).
4. Ecosystem units with an abundant herb and shrub layer dominated by fruit producing forage species, particularly soapberries or blueberries, provides an abundance of ground squirrels, and/or is in close proximity to salmon bearing streams represent best fall feeding habitat (rich and wet site series generally yield an abundance of these plant species [Michelfelder 2004]).
5. Open, recently disturbed sites (i.e., structural stages 2, 3) and to a lesser degree, late successional forests with an open, heterogeneous tree canopy (i.e., structural stage 7) yield an abundance and high diversity of forage plants.

6. Intermediate aged forests (i.e., structural stages 4, 5, and 6) generally have poor forage value. However, intermediated aged forests, especially those in structural stage 6, with an *open* tree canopy (i.e., less than 65% canopy cover) may also yield abundance and high diversity of forage plants (Gyug, et al., 2004).

Table 5: Grizzly Bear Spring and Fall Habitat Ratings in the LAA

Ecosite Phase	Habitat Ratings by Structural Stage																	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
	0		1		2		3a		3b		4		5		6		7	
Aspen – Kinnikinnick							3	3	3	3			4	5	4	4		
Alaska birch – White spruce – Willow							3	4	3	4			4	4	4	4		
Dwarf birch – Lichen							5	5										
Black spruce – Sphagnum									3	3			3	3	3	4		
Sedge Fen					2	3												
Cliff			5	6														
Exposed Soil			6	6	5	6												
Subalpine fir – Crowberry – Lichens							4	3	4	3			4	3	4	3	4	4
Subalpine fir – Feathermoss							2	3	2	3			3	3	4	4	4	4
Subalpine fir – Labrador Tea							2	2	2	2			3	3	3	4	4	4
Subalpine fir – Dwarf birch – Crowberry							3	3	3	3			4	3	4	3	4	3
Gravel Bar			4	3														
Marsh					3	3												
Mountain heather meadow					5	3												
MW Mountain avens – Dwarf willows					4	3	4	4	4	4								
Open Water	5	6																
Pond	5	6																
Balsam poplar													2	3				

Ecosite Phase	Habitat Ratings by Structural Stage																	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
	0		1		2		3a		3b		4		5		6		7	
– Horsetail																		
Placer Mine			5	5	5	5	4	4	4	4								
River	5	5																
Rock Outcrop			6	6														
Road	6	6																
Dwarf birch – Northern rough fescue (tall shrub)							3	3	3	3								
Black spruce – Cladina									3	3			3	4	4	4		
White spruce – Feathermoss													3	4	4	4	4	4
White spruce – Horsetail							2	3	2	3			3	4	3	4	3	3
Black spruce – Labrador Tea – Feathermoss							3	3	3	3			4	4	4	4	4	4
Talus			5	5														
Willow – Groundsel							4	2	3	3								
Willow – Horsetail									2	3								
Willow – Mountain sagewort							4	3	4	3								
Willow – Sedge wetland					2	3	3	3	3	3								

NOTES:
See Table 2 for a key to structural stages and Appendix A for a description of each ecosite phase.
Habitat suitability rankings are as follows: 1 = High, 2 = Moderately high, 3 = Moderate, 4 = Low, 5 = Very low and 6 = nil.

Rating Adjustments

Data from a number of intensive grizzly bear studies have been used to develop ZOIs and

DCs to model grizzly bear habitat (AXYS, 2001). Some of the more relevant information has been summarized below:

- On a seasonally closed road, the mean distance that bears were found from roads increased from 655 m to 1,222 m when a closed road was opened (Kasworm and Manley 1990).

- In Montana, areas within 500 m of roads were used significantly less than expected in the spring and fall (Aune, et al., 1986). For bears not thought to be habituated to roads, avoidance of areas was noted within 500 m of roads for spring and summer and avoidance of areas up to 1000 m was noted in the fall.
- In Yellowstone National Park, grizzly bears avoided habitat within 500 m of roads in spring and summer and within 3 km in the fall (Mattson, et al,. 1987).

Mapping adjustments were developed for the Project (Table 6) based on the above guidance from the literature to upgrade or downgrade initial habitat ratings to reflect the distance to disturbance features and anticipate grizzly bear response within the context of The Project Area. Table 6 summarizes the mapping adjustments for the study area.

Table 6: Disturbance Features and Associated Ratings Adjustments for Zones of Influence in the Grizzly Bear Habitat Model

Disturbance Feature	ZOI (m)	Disturbance Coefficient
Baseline – Mine Facility	400	-1
Baseline – Access Road	400	-1
Operations – Mine Facility	800	-1
Operations – Access Road	500	-1

1.5.2 Moose

Name: *Alces alces*

Species Code: M-ALAL

Status: Moose are not considered a species-at-risk and national and territorial populations are considered secure.

Distribution

Territorial Range:

Moose are found throughout the Yukon, however are more abundant in the southern portion of the territory. Moose are not evenly distributed throughout their range, but instead concentrated in certain areas. Northern populations are located in forested patches that line rivers along the arctic coast, while southern populations inhabit the tree line and subalpine shrub zone (Environment Yukon 2010).

Territorial Context:

The moose population in the Yukon is estimated between 65,000 and 71,000 individuals.

Project Area: Mayo

Ecozone: Boreal Cordillera

Ecoregion: Yukon Plateau-North

Biogeoclimatic Zones: Subalpine and Forested Zones

Ecology and Key Habitat Requirements

Moose are one of the most abundant and widespread wildlife species in the Yukon. Densities are generally low, compared to more productive habitats with the highest densities occurring in the southern portion of the territory at approximately 200 moose per 1,000 km² (YFWCM 1996).

Moose are frequent inhabitants of riparian areas and areas of recent disturbance, particularly those characterized by early seral stages in forest maturation. In winter, moose will migrate to their winter range that is likely at a lower elevation, providing greater foraging opportunities and reduced snow pack. Winter ranges are likely to include early seral stage vegetation, particularly willows, and may include wetland and floodplain habitats, as well as disturbed sites such as cutblocks or roads.

In general, snow depth is an important factor influencing ungulate browse availability (accessibility) as well as the energetic cost of movement and should be considered in assessing habitat use. Although moose have evolved morphological adaptations (e.g. long legs) to tolerate relatively deep snow conditions, variation in snowfall between habitat types is an important consideration affecting winter habitat capability/suitability. Snow depth of 60 cm has been cited as restricting movements of cows and calves and 100 cm has been described as the critical depth for moose (Langin and Eastman 1990).

Specific habitat attributes that influence snow depths are aspect, canopy closure and slope. In general, warmer aspects (south-facing slopes) provide shallower snow depths because they receive more direct sunlight. In addition, snow depths are shallower on steeper slopes than on flat areas because the same amount of snow is distributed over a greater surface area. Finally, tree crowns can intercept considerable amounts of snow, therefore, the greater the canopy closure the easier it is for ungulates to travel and search for food. Some researchers have suggested moose require at least 30% canopy closure in boreal mixed-wood forests (Romito, et al., 1995) while others have suggested a considerably higher canopy closure (70%) (Costain 1989). Clearly, the amount of canopy closure required by moose will vary according to local snow conditions and weather patterns. Overall, mature (structural stage 6) and old growth (structural stage 7) stands with canopy closures >30% likely provide adequate snow interception for moose during early winter with slightly higher (>50%) canopy closure requirements during late winter.

Habitat Use-Life Requisites and Season of Use

Feeding

Feeding in spring through to summer is focused on new buds and growths on willows with yellow-pond lilies providing a secondary energy source. In summer, waterways become important feeding areas for moose. Twigs, leaves, shrubs, and aquatic plants make up the bulk of food sources during this time (Environment Yukon 2010).

Winter becomes a sensitive time for food availability for moose. As such, structural stage is an important variable, which is strongly correlated with the availability of shrubby vegetation and winter browse. Structural Stage 3 (low and high shrub) would likely provide the most suitable winter foraging habitats where food sources are typically restricted to the twigs of willow, alder, poplar or birch. In years of heavy snowfall, moose will migrate towards lower valley regions to seek out these habitats specifically.

Reproduction

Rutting takes place along the tree line in subalpine zones and coincides with periods of estrous for adult females. Breeding occurs in the fall, typically between the last week of September and the first week of October. As snow begins to retreat in the spring, pregnant cows will seek out secluded places to give birth that can include the tree line of the subalpine zone, or along river corridors. Calves are born between mid-May and mid-June. Moose are highly productive in the Yukon and begin breeding at 1.5 years of age, repeating on an annual or biannual cycle (Environment Yukon 2010). Twins and triplets are common in years or areas where food is plentiful. Calves can be prone to predation by grizzly bears, particularly in the southwest portion of the Yukon where grizzlies frequent the subalpine in spring. The degree to which this holds true for the wildlife LAA is unknown however, similar predation behavior is assumed to take place opportunistically as a minimum where grizzly spring feeding habitat overlaps areas where moose cows and calves are present.

Security

In general, moose depend on forested areas as opposed to topography for security habitat (Luttmerding, et al. 1990). Dense stands of immature coniferous forest provide optimal security cover (Langin and Eastman 1990). During summer months, water bodies provide critical sources of refuge from predators (Environment Yukon 2010). Moose predation is high during winter months. On average, Yukon wolf packs will kill a moose every five or six days where available, concentrating on vulnerable individuals (i.e., calves, mature or sick individuals). Dense thickets can provide protection from such attacks.

For reproductive females, elevation can act as a form of security, providing protection from predators less likely to inhabit higher areas. During calving, cows are particularly sensitive to seeking out secluded areas such as subalpine areas to minimize risk of predation on calves (Environment Yukon 2010).

Thermal

While moose are more able to withstand cold stress, they do not easily tolerate heat. Therefore, wetlands, lakes, and other aquatic areas provide moose with adequate habitat for cooling in the summer. Inclement spring weather has the potential to induce thermal stress in calves, therefore habitats with high canopy closure (>50%) and low soil moisture assist in thermoregulation (MacCracken, et al., 1997). In winter, moose will seek out warm aspects with highest solar radiation on cold days. However, due to a dense undercoat, moose may also be prone to heat stress in winter, and may seek out shaded habitat for cooling (Renecker and Hudson 1986).

Seasons of Use

Moose require feeding, reproductive, security, and thermal habitat differentially throughout the year. Table 7 summarizes the life requisites for moose for each month of the year.

Table 7: Seasonal life requisites for moose described by month for the Yukon (*F=Feeding, R=Reproduction, S=Security, T=Thermal*)

Life Requisites	Month	Season
F, S, T	January	Winter
F, S, T	February	Winter
F, S, T	March	Winter
F, S, T	April	Winter
F, R, S, T	May	Spring
F, R, S, T	June	Spring
F, R, S, T	July	Summer
F, S, T	August	Summer
F, R, S, T	September	Fall
F, R, S, T	October	Fall
F, S, T	November	Winter
F, S, T	December	Winter

Winter is the most critical season for moose survival because diminished food resources (in terms of accessibility, availability and quality) and cold temperatures. Additionally, high snowfall accumulations can hinder moose movement and facilitate predation by wolves. Winter feeding and thermal requirements have been selected as key life requisites carried forward in the habitat modeling for moose.

Model Development

Yukon moose habitat requirements are well-documented, and support the selection of a 6-class rating scheme (Table 8), based on RIC 1999.

Table 8: Wildlife Habitat Ratings for Moose

Code	Suitability/Quality
1	High
2	Moderately high
3	Moderate
4	Low
5	Very low
6	Nil (habitat not present)

NOTE:

* Habitat ratings are based on the application of the ratings assumptions listed below within individual ground survey plot locations, professional judgement and consideration of the larger landscape context the habitat polygon is located. A description of ratings assumptions is provided below.

Rating Assumptions

A description of habitat rating assumptions are listed below, while Table 9 summarizes habitat ratings applied to moose for winter feeding and winter thermal habitat.

1. Spring/Summer: Structural stages 3, 3a, and 3b, particularly clear-cuts and floodplains provide optimal forage habitat during the growing season (rated as 1 or 2), while structural stages 4 and 5 are less valuable (rated as 3 or 4), and structural stages 5 – 7 are of very little to no value (rated as 5 or 6).
2. Fall/Winter: Structural stages 3a and 3b provide optimal forage habitat during the winter (rated as 1 or 2), while all other structural stages provide little in the way of forge habitat (rated as 3 to 6).
3. Security habitat is provided by structural stages 3b, 4, 5, 6, and 7, and if these structural stages occur within a habitat alone or in combination, then the habitat will be rated high (1 to 2). If these structural stages do not occur in a habitat, then the habitat is of less value for security and will be rated low (3 to 6). Forests with a canopy closure >65% provide optimal thermal habitat and will be rated high (1 to 2), forests with canopy closure 1 – 50% are of less value and receive ratings of 3 to 6. Habitats that provide access to aquatic environments during the summer are considered important and will be rated high (rated as 1 or 2). Ecosystems without aquatic environments are of less valuable and will be rated low (rated as 3 to 6).

Table 9: Moose Winter Habitat Ratings in the LAA

Ecosite Phase	Habitat Ratings by Structural Stage																	
	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal
	0		1		2		3a		3b		4		5		6		7	
Aspen – Kinnikinnick							3	4	3	4			5	4	5	4		
Alaska birch – White Spruce – Willow							3	4	3	4			3	3	4	3		
Dwarf birch – Lichen							5	5										
Black spruce – Sphagnum									5	5			4	5	4	5		
Sedge Fen					6	5												
Cliff			5	5														
Exposed Soil			6	6	5	5												
Subalpine fir – Crowberry – Lichens							5	5	5	5			4	4	4	4	5	3

Ecosite Phase	Habitat Ratings by Structural Stage																	
	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal
	0		1		2		3a		3b		4		5		6		7	
Subalpine fir – Feathermoss							3	4	3	4			4	3	5	2	5	2
Subalpine fir – Labrador Tea							2	3	2	3			3	3	4	3	5	2
Subalpine fir – Dwarf birch – Crowberry							4	5	4	5			4	4	4	4	5	3
Gravel Bar			6	6														
Marsh					5	6												
Mountain heather meadow					5	5												
Mountain avens – Dwarf willows					6	5	5	6	5	6								
Open Water	6	6																
Pond	6	6																
Balsam poplar – Horsetail													2	2				
Placer Mining			5	5	5	5	4	5										
River	6	5																
Rock Outcrop			6	5														
Road	6	5																
Dwarf birch – Northern rough fescue (tall shrub)							4	4	4	4								
Black spruce – Cladina									4	3			4	3	4	2		
White spruce – Feathermoss													2	3	2	2	4	2
White spruce – Horsetail							3	2	3	2			3	2	3	2	4	2
Black spruce – Labrador Tea – Feathermoss							3	3	3	3			4	2	4	2	4	2
Talus			5	6														
Willow – Groundsel							3	4	3	3								

Ecosite Phase	Habitat Ratings by Structural Stage																	
	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal	Feeding	Thermal
	0		1		2		3a		3b		4		5		6		7	
Willow – Horsetail									3	3								
Willow – Mountain Sagewort							3	3	3	3								
Willow – Sedge wetland					5	5	2	4	2	4								

NOTES:
Habitat suitability rankings are as follows: 1 = High, 2 = Moderately high, 3 = Moderate, 4 = Low, 5 = Very low and 6 = nil.
See Table 2 for a key to structural stages and Appendix A for a description of each ecosite phase.

Rating Adjustments

In general, moose tolerate human presence to a greater degree than many ungulate species.

Nevertheless, there is evidence of reduced habitat use by moose around well-traveled roads and other facilities, relative to that in comparable undisturbed habitats (Skinner 1996). Based on a literature review and expert consultation, Norecol, Dames and Moore Inc. (1998) suggested that habitats be de-rated in areas surrounding industrial facilities and regularly used roads or highways. Baseline studies (Stantec 2010a) indicated that moose use the South McQuesten and Haggart Creek roads and undeveloped areas within the proposed Project footprint. Tracks were seen regularly along the roads length as well as moose droppings. Evidence of vegetation browsing by moose was also noted along the access road and in areas within the proposed mine site footprint. No ZOIs or DCs were applied to the baseline scenario.

Given the relative “remoteness” of the Project, the fact that moose were using the road and areas near the mine site footprint at baseline, a ZOI of 200 m was assigned to the operations scenario around the mine site footprint and along the full length of the access road. Habitat ratings were downgraded by a DC of (-1) (Table 10). Without certainty as to the response of moose to increased sensory disturbance around the operating mine site and along the access road (via increased traffic volumes) this ZOI and DC was derived with the expectation that moose habitat quality will be reduced compared to baseline conditions. The 200 m distance is assumed to be a conservative overestimate based on baseline field data professional judgment related to expected moose response.

Table 10: Disturbance Features and Associated Ratings Adjustments for Zones of Influence in the Moose Habitat Model

Disturbance Feature	ZOI (m)	Disturbance Coefficient
Operations – Mine Facility	200	-1

Operations – Access Road	200	-1

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APPENDIX A

Ecosystem Descriptions

Victoria GOLD CORP

Stantec

1 ECOSYSTEM DESCRIPTIONS FOR THE EAGLE GOLD PROJECT AREA

1.1 Subalpine Zone

Seven ecosystem units are recognized within the Subalpine Zone.

1.1.1 Subalpine Fir – Dwarf Birch – Crowberry

Map Code: FP

Description: This unit is the only recognized treed unit in the Subalpine zone, and represents open canopy forests of subalpine fir. The trees are often uniformly spread out, with a canopy cover of 10-25%. Tree height rarely exceeds 7m due to the severe conditions in this zone as well as stand age and soil conditions. Occurring on upper ridges and high plateaus, the parent materials for this unit is weathered bedrock or colluvium. In some locations this unit does extend into the forested zone.

Overstorey Species: *Abies lasiocarpa*

Shrubs: *Betula glandulosa; Vaccinium uliginosum, Vaccinium vitis-idaea, Empetrum nigrum, Salix* spp.

Herbs: *Festuca altaica, Calamagrostis canadensis, Artemisia arctica, Festuca altaica, Pedicularis labradorica, Epilobium angustifolium*

Mosses: *Hylocomium splendens, Pleurozium schreberi, Polytrichum* spp.

Lichens: *Cladina stellaris, Cladina rangiferina, Peltigera* spp.

Soil/Site Characteristics:

Moisture regime:	dry to moist
Nutrient regime:	poor to medium
Parent material:	weathered bedrock or colluvium
Slope:	10-35
Aspect:	variable
Elevation:	1175-1350
No. of plots:	5
Reference plots:	EGR97, EGL15, and EGR304

Disturbances: Fires do occur in this unit, due to its position adjacent to forested areas lower down.

Comments: The vegetation for this unit is similar to the SA unit, but with 10-25 cover of subalpine fir. The cover of dwarf birch in both units is usually > 50%.

1.1.2 Mountain Avens – Dwarf Willows

Map Code: MW

Description: This subalpine dwarf shrub/sparse herb unit is dominated by mountain avens and dwarf willow. It occurs on the highest, exposed locations in the study area with dry, shallow, often rubbly soils such as ridge tops and hummocky areas. The height of the dwarf shrubs is very low, usually < 5 cm. Moss cover is low but lichen cover is high. The parent material is colluvium or weathered bedrock, and soil development is weak. Mounds of rocks and stones created by cryoturbation (frost heave) are common in these areas. Herbs are more abundant on warm aspects in the area of transition to open forest (mapped as MWw2d).

Shrubs: *Dryas integrifolia, Dryas hookeriana, Vaccinium uliginosum, Arctostaphylos rubra, Empetrum nigrum, Salix reticulata*

Herbs: *Festuca altaica, Polygonum viviparum, Pedicularis lanata, Hedysarum alpinum, Silene acaulis*

Mosses: *Racomitrium lanuginosum*

Lichens: *Cetraria* spp*., Masonhalea richardsonii, Stereocaulon* spp*., Umbilicaria hyperborea, Dactylina artica*

Soil/Site Characteristics:

Moisture regime:	very dry to dry (although seasonally moist with snowmelt)
Nutrient regime:	poor to medium
Parent material:	weathered bedrock or colluvium
Slope:	10-35
Aspect:	variable
Elevation:	1350-1500
No. of plots:	0
Reference plots:	Ecological information derived from EGL206, EGR74

Disturbances: The exposure level is high and includes wind, extreme cold, cryoturbation, and occasionally animal browse (caribou).

Comments: Differs from MM by occurring in convex slope positions (instead of concave late snowmelt areas), and lacking significant cover of mountain heathers.

1.1.3 Mountain Heather Meadow

Map Code: MM

Description: Arctic white heather (four-angled mountain heather) and crowberry are the primary dwarf shrubs in this subalpine ecosystem type. The mats of heathers are often quite dense, but usually less than 15 cm in height. Herbs are sparse but diverse; and alpine mosses and lichens are common. The unit occurs in concave late snow-melt areas, and often on north aspects. Mounds of

rocks and stones created by cryoturbation (frost heave) are common in these areas. The parent material is colluvium or weathered bedrock, and soil development is weak.

Shrubs: *Cassiope tetragona, Empetrum nigrum, Vaccinium uliginosum, Empetrum nigrum, Salix arctica, Dryas hookeriana, Sibbaldia procumbens*

Herbs: *Festuca altaica, Gentiana glauca, Lycopodium alpinum, Hierchloe alpina, Anemone narcissiflora*

Mosses: *Polytrichum* spp., and *Racomitrium lanuginosum* (low cover)

Lichens: low to moderate cover of *Cladina* spp. and *Cetraria* spp.,

Soil/Site Characteristics:

Moisture regime:	dry to moist (late snowmelt areas)
Nutrient regime:	poor
Parent material:	weathered bedrock or colluvium
Slope:	10-50
Aspect:	variable, but usually north
Elevation:	1250-1500
No. of plots:	2
Reference plots:	EGL206, EGR74

Disturbances: Once established, heather communities are quite stable. Disturbances include frost heave and rock slides.

Comments: Differs from the MW by the high cover of dwarf mountain heathers.

1.1.4 Dwarf Birch – Lichen (low shrub)

Map Code: BL

Description: This unit is dominated by dwarf birch and lichens, with the dwarf birch typically being less than 100 cm in height. The distribution of the dwarf birch is often patchy, providing light and space for lichens to develop. Willows are also common but typically have <10% cover. Lichen cover increases on drier areas such as exposed weathered bedrock and bouldery areas. Moss cover is low to moderate. The parent materials are colluvium, weathered bedrock and bedrock.

Shrubs: *Betula glandulosa, Vaccinium uliginosum, Vaccinium vitis-idaea, Empetrum nigrum, Salix* spp.

Herbs: *Festuca altaica, Hierchloe alpina, Lupinus arcticus, Pedicularis labradorica, Poa arctica, Polygonum viviparum*

Mosses: *Polytrichum juniperinum, Hylocomium splendens, Racomitrium canescens*

Lichens: *Cetraria* spp*., Cladina mitis, Cladina rangiferina, Cladina stellaris, Stereocaulon* spp.

Soil/Site Characteristics:

Moisture regime:	very dry to mesic

Nutrient regime:	poor
Parent material:	weathered bedrock or colluvium
Slope:	0-55
Aspect:	variable
Elevation:	1175-1450
No. of plots:	10
Reference plots:	EGR76, EGL307, EGR71

Disturbances: Fire occurs adjacent to forested areas

Comments: Differs from the SA in that the dwarf birch height is usually less than 100 cm and has a patchier, non-continuous distribution. The lower height is the result of growing in drier, more exposed situations such as in rocky areas, the tops of hummocks or knolls, or areas with a high cover of weathered bedrock.

1.1.5 Dwarf Birch – Northern Rough Fescue (tall shrub)

Map Code: SA

Description: This unit consists of extensive, continuous tall thickets of dwarf birch with heights typically between 1 and 2 m. Scattered willows and dwarf shrubs also occur, but dwarf birch dominates. Northern rough fescue (Altai fescue) is present throughout, but its cover increases in gaps, and following fires. The SA unit shares many of the same species as the BL unit but the high cover of dwarf birch creates more shade which in turn discourages the lichens, resulting in a high cover of mosses. Parent materials are dominantly weathered bedrock, although pockets of colluvium and till also occur.

Overstorey Species: scattered *Abies lasiocarpa* (< 10%)

Shrubs: *Betula glandulosa; Vaccinium uliginosum, Vaccinium vitis-idaea, Empetrum nigrum, Salix glauca, Salix planifolia*

Herbs: *Festuca altaica, Calamagrostis canadensis, Artemisia arctica, Pedicularis labradorica*

Mosses: *Hylocomium splendens, Pleurozium schreberi, Polytrichum juniperinum*

Lichens: *Peltigera* spp., *Cladina stellaria*

Soil/Site Characteristics:

Moisture regime:	dry to mesic
Nutrient regime:	medium
Parent material:	weathered bedrock or colluvium
Slope:	5-45
Aspect:	variable
Elevation:	1175-1410

No. of plots: 11
Reference plots: EGL52, EGR306

Disturbances: Locations occurring near forested areas will burn at regular intervals. Dwarf birch burns readily, allowing ample light onto the soil surface, and resulting in a rapid cover of grasses such as northern rough fescue, and herbs such as fireweed.

Comments: Differs from the BL by having a taller and more continuous cover of dwarf birch, and a greater moss to lichen ratio.

1.1.6 Willow – Groundsel

Map Code: WG

Description: This unit has an almost continuous cover of tall willows (1.5 to 5 m). Several species of willows are typically present. Herb cover is moderate, with high cover within gaps. The WG unit is found in moist to wet draws, gulley bottoms, and riparian areas along streams and creeks.

Overstorey Species: typically none

Shrubs: *Salix* spp*. (planifolia, glauca, pulchra, arbusculoides, bebbiana), Alnus incana, Rosa acicularis, Picea glauca*

Herbs: *Calamagrostis canadensis, Senecio triangularis, Aconitum delphinifolium, Equisetum arvense, Mitella nuda, Festuca altaica, Mertensia paniculata*

Mosses: *Aulocomnium palustre, Hylocomium splendens, Sphagnum* spp.

Lichens: often absent

Soil/Site Characteristics:

Moisture regime: moist to very wet
Nutrient regime: medium to rich
Parent material: fluvial
Slope: 0-15
Aspect: variable
Elevation: 1150-1350
No. of plots: 2
Reference plots: EGL19, EGL58

Disturbances: Fire less likely due to moisture.

Comments: Differs for WM by being restricted to riparian areas and wet draws.

1.1.7 Willow – Mountain Sagewort

Map Code: WM

Description: This is also a shrub unit, dominated by willows, and occurring on lower slopes, sides of gullies, or in high plateau areas where the willow out-competes the dwarf birch on slightly richer and wetter sites. At high elevations trees are absent; at lower elevations subalpine fir or spruce may be present.

Overstorey Species: *Abies lasiocarpa, Picea glauca*

Shrubs: *Salix* spp*. (pulchra, planifolia, glauca, arbusculoides, bebbiana), Alnus incana, Vaccinium vitis-idaea, Picea glauca, Betula glandulosa, Ledum groenlandicum*

Herbs: *Festuca altaica, Mertensia paniculata, Artemisia arctica, Epilobium angustifolium, Aconitum delphinifolium, Calamagrostis canadensis, Lupinus arcticus*

Mosses: *Hylocomium splendens, Pleurozium schreberi*

Lichens: *Peltigera apthosa, Cladina* spp.

Soil/Site Characteristics:

Moisture regime:	mesic to moist
Nutrient regime:	medium
Parent material:	weathered bedrock or colluvium, occasionally on till
Slope:	10-35
Aspect:	variable
Elevation:	1150-1300
No. of plots:	2
Reference plots:	EGL205

Disturbances: Fire history

Comments: Differs from WG by occurring in upland areas; shrub height often lower than 1.5 m, with frequent gaps.

1.2 Forested Zone

The forested zone has 20 recognized ecosystem types, although a number of them also occur in the Subalpine zone (see above).

1.2.1 Trembling Aspen – Kinnikinnick

Map Code: AK

Description: This unit is relatively common in the forested zone, but generally as discreet groves of trees, and never covering large areas. White spruce and Alaska birch are also frequently found

mixed in or adjacent to the aspen. A variety of shrubs are also found in these stands, as listed below. Moss and lichen cover is generally low. Trembling aspen always grows on warm sites with good soil drainage. This species can be also found at quite high elevations as long as the aspect is favorable; however at this height the aspen is more shrub-like in appearance. Scattered trembling aspen is also found extensively on soil disturbed by placer mining and gravel waste piles.

Overstorey Species: *Populus tremuloides, Picea glauca, Betula neoalaskana*

Shrubs: *Arctostaphylos uva-ursi, Shepherdia canadensis, Vaccinium vitis-idaea, Rosa acicularis*

Herbs: *Geocaulon lividum, Rubus pubescens, Linnaea borealis, Cornus canadensis, Pyrola secunda, Lycopodium annotinum*

Mosses: *Hylocomium splendens*

Lichens: *Peltigera apthosa*

Soil/Site Characteristics:

Moisture regime:	dry to mesic
Nutrient regime:	medium to rich
Parent material:	colluvium
Slope:	30-70
Aspect:	warm
Elevation:	700-1100
No. of plots:	3
Reference plots:	EGR402, EGL39

Disturbances: As an early successional species, aspen can come in thickly after fire, to be eventually overtopped by white spruce. Aspen can continue to persist on warm aspects and steep slopes with unstable soils and colluvium.

Comments: This is the only unit where trembling aspen is the dominant species.

1.2.2 Juniper – Kinnikinnick

Map Code: JK

Description: This unit is very uncommon in the mapping area and is only mapped present as very small patches; as such it has not been mapped. It is essentially the same as the AK unit (above) but lacks the tree cover, and has a high cover of shrubs (listed below). Lichens are present but scattered.

Shrubs: *Juniperus communis, Arctostaphylos uva-ursi, Shepherdia canadensis, Vaccinium vitis-idaea, Rosa acicularis*

Herbs: *Geocaulon lividum, Rubus pubescens, Linnaea borealis, Cornus canadensis, Pyrola secunda, Lycopodium annotinum*

Mosses: none

Lichens: *Cladina* spp.

Soil/Site Characteristics:

Moisture regime:	dry to mesic
Nutrient regime:	medium to rich
Parent material:	colluvium
Slope:	30-70
Aspect:	warm
Elevation:	700-1100
No. of plots:	0 (information on this unit was derived from field notes)
Reference plots:	EGR402, EGL39

Disturbances: Localized soil disturbance keeps trees from establishing.

Comments: This unit grows in the warmest microclimates in the study area: steep, south-facing slopes at low elevation.

1.2.3 Alaska Birch – White Spruce – Willow

Map Code: AW

Description: This unit occurs on well-drained slopes with warm aspects. In the mapping area, such sites typically occur on mid-slope positions; however they will also occur on coarse soils, or rocky knolls. The parent material is typically stabilized colluvium or shallow soils over bedrock. Alaska birch is the leading tree but, although pure stands exist, most stands have a minor component of white spruce, subalpine-fir, or aspen (or all three). Stands typically have a canopy cover of between 10 and 40%. The AW and the AK unit are the only hardwood dominated upland units in the study area (the PH unit – Balsam poplar-Horsetail- occurs along rivers and creeks).

Overstorey Species: *Betula papyrifera, Picea glauca, Abies lasiocarpa*

Shrubs: *Picea glauca, Vaccinium vitis-idaea, Alnus crispa, Rosa acicularis, Viburnum edule, Salix scouleriana*

Herbs: *Cornus canadensis, Mertensia paniculata, Pyrola secunda, Linnaea borealis, Geocaulon lividum, Epilobium angustifolium*

Mosses: *Hylocomium splendens, Pleurozium schreberi*

Lichens: *Peltigera* spp.

Soil/Site Characteristics:

Moisture regime:	dry to mesic
Nutrient regime:	rich
Parent material:	colluvium or till
Slope:	30-70

Aspect:	warm
Elevation:	700-1100
No. of plots:	7
Reference plots:	EGL213; EGR403; EGR405

Disturbances: Fire is the most likely disturbance. Birch will also regenerate quickly following fire, and will persist for many years in many stands.

Comments: This is the only unit where Alaska birch is the dominant species. The AW unit is also much more common and widespread than the AK unit. Note: in the ecosystem map data base, pure stands are indicated by the letter B (broadleaf) in the column "Stand Appearance", and mixed stands are indicated with the letter M (mixed).

1.2.4 Dwarf Birch – Lichen

Map Code: BL

Description: This is the same unit as described for the Subalpine zone.

Vegetation: same as the BL unit in Subalpine zone

Soil/Site Characteristics:

Moisture regime:	dry to moist
Nutrient regime:	poor to medium
Parent material:	colluvium
Slope:	10-60
Aspect:	variable
Elevation:	1100-1250
No. of plots:	3 plots (in Forested Zone)
Reference plots:	EGL50, EGL309

Successional Status: Fire

Comments: This unit is considered to be subalpine unit, but with occasional incursions into the forested areas.

1.2.5 Black Spruce – Sphagnum

Map Code: BS

Description: This is bog unit, with open canopy black spruce. These trees are usually stunted (trees 0.5 to 5 m). Occurring on organic soils; this unit is found in flat to gently sloping areas in the valley bottoms.

Overstorey Species*: Picea mariana* (generally < 5m in height)

Shrubs: *Picea mariana, Ledum groenlandicum, Betula glandulosa, Oxycoccus microcarpus, Empetrum nigrum, Salix myrtillifolia, Andromeda polifolia, Rhododendron lapponicum, Arctostaphylos rubra, Vaccinium vitis-idaea*

Herbs: *Rubus chamaemorus, Eriophorum* spp*., Equisetum scirpoides, Carex aquatilis, Equisetum sylvaticum*

Mosses: *Sphagnum* spp*., Hylocomium splendens, Aulocomnium palustre*

Lichens: *Cladina stellaris, Cladina mitis*

Soil/Site Characteristics:

Moisture regime:	wet to very wet
Nutrient regime:	poor
Parent material:	organic
Slope:	level to 4 %
Aspect:	n/a
Elevation:	625-800
No. of plots:	3
Reference plots:	EGR419, EGR107

Disturbances: Fires are rare in these wet areas but do occur on occasion.

Comments: Differs from the SL unit by growing on organic soils.

1.2.6 Subalpine Fir – Crowberry – Lichens

Map Code: FC

Description: This unit has open forests of subalpine fir, with a canopy cover between 10 - 25% and tree heights between 5-8 m. These ecosystems are found on mid to upper slope positions (such as ridges); and also on gravelly soils along gullies at lower elevations. Due to the open canopy, crowberry and lichen cover is high, particularly on the drier sites where tree cover is low and patches of exposed mineral soil occur. Shrub cover increases with soil moisture and can be high in places.

Overstorey Species: *Abies lasiocarpa*

Shrubs: *Empetrum nigrum, Betula glandulosa, Betula papyrifera, Vaccinium vitis-idaea, Ledum groenlandicum, Vaccinium uliginosum, Vaccinium caespitosum, Salix* spp. (*glauca, planifolia, pulchra*)

Herbs: *Festuca altaica, Linnaea borealis, Artemisia arctica, Epilobium angustifolium, Pyrola secunda, Lycopodium complanatum, Aconitum delphinifolium*

Mosses: *Hylocomium splendens, Pleurozium schreberi*

Lichens: *Cladina stellaris, Cladina rangiferina, Cladina mitis, Peltigera* spp., *Stereocaulon* spp.

Soil/Site Characteristics:

Moisture regime:	dry to mesic
Nutrient regime:	poor
Parent material:	colluvium, or glacial-fluvial gravels (at lower elevations)
Slope:	10-80
Aspect:	variable
Elevation:	950-1350
No. of plots:	24
Reference plots:	EGR 93; EGL 63; EGL210: EGR120

Disturbances: The most common disturbance is fire. Following fire more deciduous shrubs and herbs develop.

Comments: Differs from the FF unit by having open canopy, drier soils, and high lichen and crowberry cover. It differs from the FP by having less dwarf birch, and usually occurring at lower elevations. This unit has the second highest coverage in the mapping area.

1.2.7 Subalpine Fir – Feathermoss

Map Code: FF

Description: These units are open to closed canopy forest of subalpine fir, occurring on sloping sites above the valley floor. A minor component of white spruce or Alaska birch may be present in some locations, particularly on warmer, richer sites. These stands are the one of most productive forests in study area at moderate elevations. Large areas of this unit occurring on the slopes south of the LSA have recently had forest fires, resulting in a thick cover of herbs and young shrubs and trees.

Overstorey Species: *Abies lasiocarpa* (*Betula neoalaskana, Picea glauca*)

Shrubs: *Alnus crispa, Ribes triste, Vaccinium vitis-idaea, Rosa acicularis*

Herbs: *Cornus canadensis, Geocaulon lividum, Equisetum sylvaticum*

Mosses: *Hylocomium splendens, Pleurozium schreberi, Ptilium crista-castrensis, Dicranum* spp.

Lichens: *Peltigera* spp. (*apthosa, canina*), *Nephroma arcticum*

Soil/Site Characteristics:

Moisture regime:	mesic to moist
Nutrient regime:	medium to rich
Parent material:	till or stabilized colluvium
Slope:	5-45
Aspect:	variable
Elevation:	850-1300
No. of plots:	5
Reference plots:	EGL 49, EGR111

Disturbances: Fire is the most common disturbance, although trees may be damaged by localized snow slides in some locations.

Comments: Differs from the FC by having a more closed canopy and fewer herbs and shrubs as a result of more shade on the forest floor. It differs from the FM by occurring on drier sites or those generally lacking in permafrost.

1.2.8 Subalpine Fir – Labrador Tea

Map Code: FM

Description: This unit occurs on lower slopes and north aspect slopes with permafrost. Sub-alpine fir is the leading tree species. Trees are often growing at random angles due to the uneven melting of the permafrost. There is a high cover of mosses.

Overstorey Species: *Abies lasiocarpa*

Shrubs: *Ledum groenlandicum, Betula glandulosa, Vaccinium vitis-idaea, Picea mariana, Empetrum nigrum, Salix* spp.

Herbs: *Equisetum scirpoides, Equisetum sylvaticum, Cornus Canadensis, Rubus chamaemorus*

Mosses: *Hylocomium splendens, Pleurozium schreberi, Sphagnum* spp., *Dicranum* spp.

Lichens: *Peltigera apthosa, Nephroma arcticum, Cladina stellaris*.

Soil/Site Characteristics:

Moisture regime:	moist to wet
Nutrient regime:	poor
Parent material:	organic veneers
Slope:	10-55
Aspect:	variable, but often cool
Elevation:	900-1150
No. of plots:	8
Reference plots:	EGL26, EGR124

Disturbances: Permafrost, and forest fire

Comments: Differs from the SL unit by having subalpine fir as the leading species, otherwise the vegetation is similar. On the landscape this unit occurs on mid slopes above the SL unit. On north aspects it can occur on upper slopes.

1.2.9 Subalpine Fir – Dwarf Birch – Crowberry – Lichens

Map Code: FP

Description: This unit is essentially a subalpine unit, but does occur occasionally on the upper slopes of the Forested zone. The unit consists of open canopy of subalpine fir growing in association with dwarf birch dominated ecosystems (SA unit). See the description for this unit in the preceding section.

Soil/Site Characteristics:

Moisture regime:	dry to mesic
Nutrient regime:	medium
Parent material:	colluvium or weathered bedrock
Slope:	10-55
Aspect:	variable
Elevation:	1050-1225
No. of plots:	3 (in forested zone)
Reference plots:	EGL3, EGR 123

Disturbances: Areas of FP that occur close to forested areas may experience forest fires. This is the case on the slopes just south of the LSA where fire has resulted in a thick growth of deciduous shrubs and herbs.

1.2.10 Balsam Poplar – Horsetail

Map Code: PH

Description: This unit occurs on the active floodplains of streams and rivers. Balsam poplar is present but often mixed with white spruce, trembling aspen or Alaska birch, mountain alder and willows. Flooding on these sites may be frequent. The balsam poplar, as well as the white spruce, can grow up to 20 m in height if undisturbed. These sites are considered to be rich due to the frequent deposition of silt and clay, good soil drainage, and nutrients brought by flowing waters.

Overstorey Species: *Populus balsamifera, Picea glauca* (*Populus tremuloides, Betula neoalaskana*)

Shrubs: *Rosa acicularis, Viburnum edule, Alnus incana, Cornus stolonifera, Salix* spp*., Ribes triste, Picea glauca*

Herbs: *Equisetum arvense, Fragaria virginiana, Rubus pubescens, Cornus canadensis, Mitella nuda, Mertensia paniculata, Calamagrostis canadensis, Pyrola asarifolia*

Mosses: *Ptilium crista-castrensis, Hylocomium splendens*

Soil/Site Characteristics:

Moisture regime:	moist to wet
Nutrient regime:	rich
Parent material:	fluvial
Slope:	level
Aspect:	n/a
Elevation:	600 – 750
No. of plots:	1
Reference plots:	EGR404

Disturbances: Overbank flooding; frequent deposition of silt and clay; occasionally shifts in the river channel; placer mining

Comments: This unit occurs in the riparian areas of active streams and rivers.

1.2.11 Dwarf Birch – Northern Rough Fescue

Map Code: SA

Description: This unit is a subalpine unit that is sometimes found in the upper portions of the Forested zone. See the full description for this unit in the preceding section.

Soil/Site Characteristics:

Moisture regime:	dry to mesic
Nutrient regime:	medium
Parent material:	colluvium
Slope:	10-50
Aspect:	variable
Elevation:	850-1325
No. of plots:	1 (in forested zone)
Reference plots:	EGR113

1.2.12 White spruce – Feathermoss

Map Code: SF

Description: This unit represents stands dominated by white spruce. While this species is common throughout the study area, it usually only forms a minor component of the stands where it occurs. In this unit, the forest stands are dominated by white spruce, and tend to occur on mid to lower slopes with rich soils and warm aspects (likely lacking permafrost). On these sites the white spruce can reach up to 20 m in height and with diameters of up to 65 cm. The conifer trees form a closed canopy, allowing little light to rich the forest floor, resulting in a high cover of feathermosses.

Overstorey Species: *Picea glauca, Abies lasiocarpa*

Shrubs: *Abies lasiocarpa, Alnus crispa, Vaccinium vitis-idaea, Shepherdia canadensis, Viburnum edule*

Herbs: *Cornus canadensis, Linnaea borealis, Mitella nuda, Geocaulon lividum, Mertensia paniculata*.

Mosses: *Pleurozium schreberi, Ptilium crista-castrensis*

Lichens: *Peltigera apthosa*

Soil/Site Characteristics:

Moisture regime:	mesic
Nutrient regime:	medium to rich
Parent material:	till or stabilized colluvium
Slope:	5-65
Aspect:	warm
Elevation:	625-1050
No. of plots:	6
Reference plots:	EGR401, EGR413

Disturbances: Forest fire

Comments: Differs from other upland units by the amount of white spruce

1.2.13 White Spruce – Horsetail

Map Code: SH

Description: This unit occurs in and immediately adjacent to riparian areas along creeks, streams, and moist draws - often occurring as very narrow band and occupying little area. The canopy is closed, resulting in an almost continuous cover of mosses, and a low cover of lichens. Soils in riparian areas are generally quite rich, so the tree growth is quite productive, with trees reaching over 20 m in height. Balsam poplar may be present.

Overstorey Species: *Picea glauca* (*Picea mariana, Abies lasiocarpa*)

Shrubs: *Rosa acicularis, Alnus incana*

Herbs: *Mertensia paniculata, Equisetum* spp. (*arvense, scirpoides, sylvaticum*), *Cornus canadensis, Linnaea borealis, Petasites palmatus*

Mosses: *Hylocomium splendens, Pleurozium schreberi, Sphagnum* spp., liverworts

Lichens: *Peltigera* spp.

Soil/Site Characteristics:

Moisture regime:	moist to wet
Nutrient regime:	medium to rich
Parent material:	fluvial
Slope:	0-15
Aspect:	variable (no aspect effect)
Elevation:	800-1075
No. of plots:	4
Reference plots:	EGL22, EGR400

Disturbances: overbank flooding, mining activities

Comments: This unit does occur along streams and rivers, but differs from the PH unit by being dominated by white spruce. It is also found along small creeks and streams.

1.2.14 Black Spruce – Cladina

Map Code: SC

Description: This unit occurs on the glacial-fluvial gravels in valley bottom positions. The soils are dry and rapidly drained, resulting in an open canopy forest with a low cover of herbs and mosses. Conversely, the abundant light on the forest floor produces a high cover of lichen. Hummocky areas may have a deciduous component of Alaska birch or trembling aspen.

Overstorey Species: *Picea mariana (Abies lasiocarpa)*

Shrubs: *Empetrum nigrum, Betula glandulosa, Betula neoalaskana, Vaccinium vitis-idaea, Ledum groenlandicum, Vaccinium uliginosum, Vaccinium caespitosum, Salix* spp.

Herbs: *Linnaea borealis, Artemisia arctica, Epilobium angustifolium, Pyrola secunda, Lycopodium complanatum*

Mosses: *Hylocomium splendens, Pleurozium schreberi*

Lichens: *Cladina stellaris, Cladina rangiferina, Cladina mitis, Peltigera* spp., *Stereocaulon* spp.

Soil/Site Characteristics:

Moisture regime:	dry to mesic
Nutrient regime:	poor to medium
Parent material:	glacial-fluvial gravels
Slope:	< 10%
Aspect:	n/a
Elevation:	600-700
No. of plots:	2
Reference plots:	EGR416, EGR417

Disturbances: The most common disturbance is fire, with herbs and deciduous shrubs regenerating following fire occurrences.

Comments: Differs from the units by having open canopy forests occurring on dry gravel deposits in the valley bottom. They also have a high cover of lichen and crowberry.

1.2.15 Black Spruce – Labrador Tea – Feathermoss

Map Code: SL

Description: This unit represent stands of black spruce growing on permafrost on lower slopes. These ecosystems are common throughout the study area and often occur in areas with cold air accumulation. Moss cover is high. The soils remain cold throughout the growing season as a result of the frozen soils, insulating properties of the moss, lack of soil oxygenation, and low accumulation of heat units. This unit is the most common mapped ecosystem in the project area.

Overstorey Species: *Picea mariana, Abies lasiocarpa*

Shrubs: *Vaccinium vitis-idaea, Picea mariana, Ledum groenlandicum, Betula glandulosa, Empetrum nigrum, Salix* spp.

Herbs: *Equisetum scirpoides, Cornus Canadensis, Rubus chamaemorus*

Mosses: *Hylocomium splendens, Pleurozium schreberi, Sphagnum* spp., *Dicranum* spp.

Lichens: *Peltigera apthosa, Nephroma arcticum, Cladina stellaris*.

Soil/Site Characteristics:

Moisture regime:	wet
Nutrient regime:	poor
Parent material:	till or organic veneers over till
Slope:	10-30
Aspect:	variable
Elevation:	675-1050
No. of plots:	20
Reference plots:	EGL 91, EGL215

Disturbances: Permafrost melting

Comments: Differs from the FM unit by having a high cover of black spruce, and occurring on lower and gentle slopes.

1.2.16 Willow – Groundsel

Map Code: WG

Description: This riparian unit is also present in the Subalpine zone and a detailed description is found in the preceding section.

1.2.17 Willow – Horsetail

Map Code: WH

Description: The Willow - Horsetail ecosystem is a low to moderately-tall, shrub unit that occurs on low benches, or in draws and depressions adjacent to flowing water. Soils are often sandy or loamy and some water movement through the soil profile is present. Gaps in the willow canopy are filled with herbs. Scattered white spruce may be present. This unit is most frequently found along the access road.

Shrubs: *Salix* spp*., Alnus tenuifolia, Rosa acicularis*

Herbs: *Carex aquatilis, Carex atherodes, Equisetum fluviatile, Galium trifidum, Calamagrostis canadensis, Glyceria borealis*

Mosses: *Mnium sp., Brachythecium* sp*.*

Soil/Site Characteristics:

Moisture regime:	very wet
Nutrient regime:	medium to rich
Parent material:	fluvial
Slope:	level
Aspect:	n/a
Elevation:	600-850
No. of plots:	1
Reference plots:	EGR415

Disturbances: Flooding, Placer miner

Comments*:* Differs from the WS by being drier (no standing water).

1.2.18 Willow – Mountain Sagewort

Map Code: WM

Description: This unit also occurs in the Subalpine zone. See preceding section for the detailed description.

1.2.19 Willow – Sedge Wetland

Map Code: WS

Description: Willow – Sedge wetlands occur in level areas in the valley bottom. Such wetlands may occur at higher locations but are small and localized. These wetland types can develop on lake shores, and floodplains, as well as in old river channels (oxbows). Several occurrences were also found in water collecting areas created by placer mining (depressions in the mine tailings). This unit recognizes two phases, sedge wetlands that are dominated by herbs (sedges and horsetails), and those that have > 20% shrubs (willows and dwarf birch in addition to the sedges).

Shrubs: *Betula glandulosa, Potentilla palustris, Salix* spp*., Ledum groenlandicum*

Herbs: *Carex aquatilis, Carex limosa, Equisetum fluviatile, Galium trifidum, Calamagrostis canadensis, Glyceria borealis*

Mosses: *Tomenthypnum nitens, Drepanocladus uncinatis, Sphagnum* spp.

Soil/Site Characteristics:

Moisture regime:	very wet
Nutrient regime:	rich
Parent material:	organic
Slope:	level
Aspect:	n/a
Elevation:	600-900
No. of plots:	2
Reference plots:	EGL12, EGR450

Disturbances: Flooding, Placer mining

Comments: Differs from marshes by being shallower, and having a continuous cover of emergent vegetation (no areas of open water).

1.2.20 Marsh

Map Code: MA

Description: Marshes occur infrequently in level areas in the valley bottom. These wetland types can develop in kettled landscape, on lake shores and depressions. They are characterized by areas of open water, with a fringe of emergent plants.

Shrubs *Potentilla palustris, Salix* spp*. (Myrica gale)*

Herbs: *Carex* spp., *Equisetum fluviatile* (*Scirpus* spp*., Menyanthes trifoliata, Triglochin maritima*)

Mosses: *Tomenthypnum nitens, Drepanocladus spp., Sphagnum* spp.

Soil/Site Characteristics:

Moisture regime:	very wet
Nutrient regime:	rich
Parent material:	organic
Slope:	level
Aspect:	n/a
Elevation:	600-900
No. of plots:	1
Reference plots:	EGR420

Disturbances: Changes in water level (such as from beavers)

Comments: Only found at lower elevations along access road.