Caribou Flats Road Restoration

An Ecological and Functional Approach

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Caribou Flats Road Restoration: An Ecological and Functional Approach

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Prepared For

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Executive Summary

The Caribou Flats roadway is a legacy mineral exploration road that goes from low to heigh elevation within the population range boundary of the Chase herd of woodland caribou (*Rangifer tarandus caribou*). The Chase caribou are considered by the federal government of Canada to be part of the Southern Mountain population of woodland caribou, which is listed on Schedule 1 of the federal *Species at Risk Act* (SARA) as Threatened. This designation indicates that if steps are not taken to address the factors threatening this species, the species is likely to become endangered.

The Recovery Strategy for the Southern Mountain population of woodland caribou in Canada provides the following recommendation: "Undertake coordinated actions to reclaim Southern Mountain caribou habitat in all currently utilized seasonal ranges through restoration efforts (e.g. restore industrial landscape features such as roads, old seismic lines, pipelines, cut-lines, temporary roads, cleared areas; reconnect fragmented annual ranges) to make it less suitable for other prey species (Environment Canada, 2014)"

In collaboration with Tsay Keh Dene Nation, our project team restored the Caribou Flats roadway by employing both functional and ecological restoration techniques. The intent of this work was to make the road less suitable for other prey species, predator travel, and human recreational and hunting use. The Caribou Flats road was an ideal candidate for restoration because it provided access from low to high elevation and was adjacent to a known caribou migration corridor. We used functional restoration techniques, including tree felling and hinging, and access control, to reduce line of sight and travel opportunities along the road. The ecological restoration techniques we applied included road decompaction, ripping, and tree planting. Before road restoration work commenced, we collected baseline vegetation and camera-trap data for reference in future monitoring work.

In the short-term, the functional restoration techniques are expected to reduce lines of sight along the road as well as reduce human use of the road. Over the long-term, the resulting reduction in roadway use is expected to facilitate ecological restoration, by allow the planted seedlings to establish and accelerate the return of the roadway to a productive mature forest environment. Through this work, our team restored 9.6 km of forest road to benefit the imperiled Chase caribou.

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1 Introduction

The Federal Recovery Strategy for the Southern Mountain population of woodland caribou (*Rangifer tarandus caribou*) cites that "habitat alteration (i.e., habitat loss, degradation, and fragmentation) from both human-caused and natural sources, and increased predation as a result of habitat alteration, have led to declining numbers throughout their distribution" (Environment Canada, 2014).

Linear disturbance features on a landscape, such as roads, power lines, and seismic lines, may facilitate increased interactions between caribou and predators (Schneider et al., 2010; Festa-Bianchet et al. 2011; Pigeon et al., 2016). Linear features allow wolves to move faster on the landscape (Dickie et. al., 2016) which may result in an increase in predator-prey interactions (Festa-Bianchet et al. 2011). In addition, habitat disturbance may reduce the spatial separation of caribou and other ungulate species, and consequently, predators (Festa-Bianchet et al. 2011; Fortin et al. 2015). The early seral habitat that results from disturbance may provide increased browsing opportunities for other ungulate species, such as moose (Fortin et al. 2015) or elk. Populations of alternate prey species may increase in the area, and subsequent changes in wolf density and distribution may increase predation risk for caribou (Fortin et al. 2015). Applying functional restoration by means of tree-felling and access control, is expected reduce the use of a roadway by predators as well as hunters (Pyper et al, 2014; Golder Associates, 2015; Pigeon et al, 2016). Whereas ecological restoration treatments of soil scarification and tree planting should accelerate the return of a linear feature to pre-disturbance states (Walder and Bagley, nd; Luce, 1997; Switalski et al, 2004.

In 2018, a collaborative project between Chu Cho Environmental (CCE), Tsay Keh Dene Nation, Wildlife Infometrics, Chu Cho Forestry, Conifex Timber Inc., Dunkley Lumber Ltd., and the Society for Ecosystem Restoration in Northern British Columbia identified 1,942.8 km of forest road with potential for restoration and/or reforestation activities, within the Chase caribou herd boundary (Rapai et al., 2018). These roadways were identified through both a desktop and field based process which sought to balance ecological, cultural and logistical considerations (Rapai et al., 2018).

From the shortlist of candidate roads, the Caribou Flats roadway was subsequently selected as a candidate for restoration activities in 2019 by Tsay Keh Dene Nation and caribou biologists most familiar with the Chase caribou herd. The road was a non – status, meaning the road had no owner with obligations, legacy mineral exploration road.

The Caribou Flats roadway was considered a strong candidate for restoration for the following reasons:

- It was adjacent to, and extended into an identified migration corridor for the Chase caribou,
- It overlapped with the Northern Caribou Ungulate Winter Range (UWR; FRPA U-7-025) in the No Harvest zone.
- The roadway was outside the timber harvesting land base and the forest licensees had no obligations on this roadway, nor was it needed for access to future timber supply.
- The road was within important habitat for the Chase caribou as identified by regional experts.
- The road provided direct access for predators from mid to high elevation caribou habitat.

- The roadway was accessed via the Tenekihi Forest Service Road which is open year-round for access Kemess mine. Year-round access provided increased access to hunters, snowmobilers and other backcountry users.
- The roadway provides access to over 2 million km^2 of road free wilderness in the Swanell River drainage.

In 2019 and 2020, our project team applied functional and ecological restoration techniques on 9.6 km of the Caribou Flats forest road network. Functional restoration (access management, tree felling and hinging, slash rollback) was applied to 50% of the treatment area, and ecological restoration techniques (soil ripping and tree planting) were applied to the other 50% of the treatment area. Figure 1 shows the location of the Caribou Flats road, and Figure 2 shows the roadway in relation to Caribou corridors, UWR, No Harvest zones, and mineral claims.

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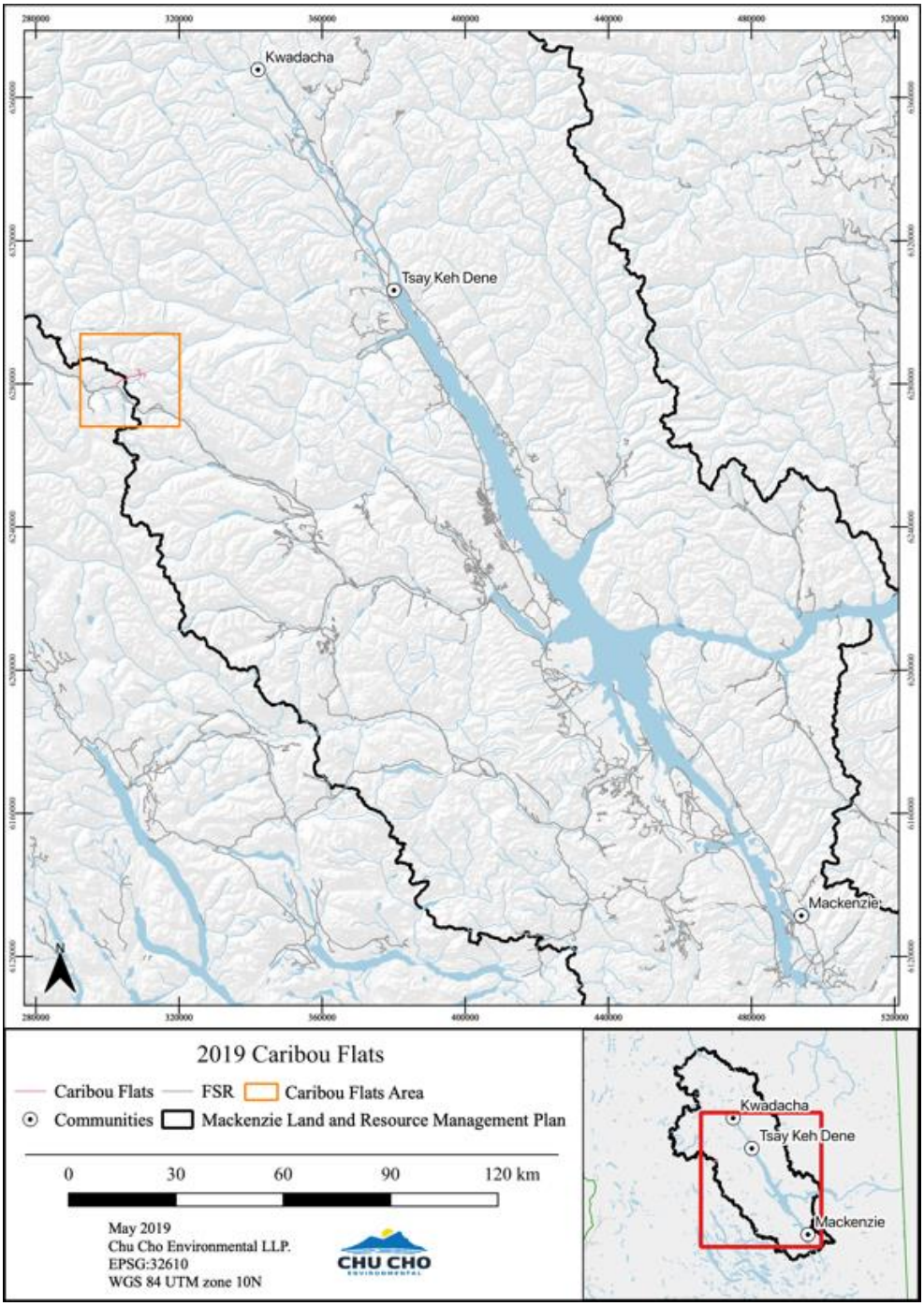


Figure 1. Location of Caribou Flats roadway

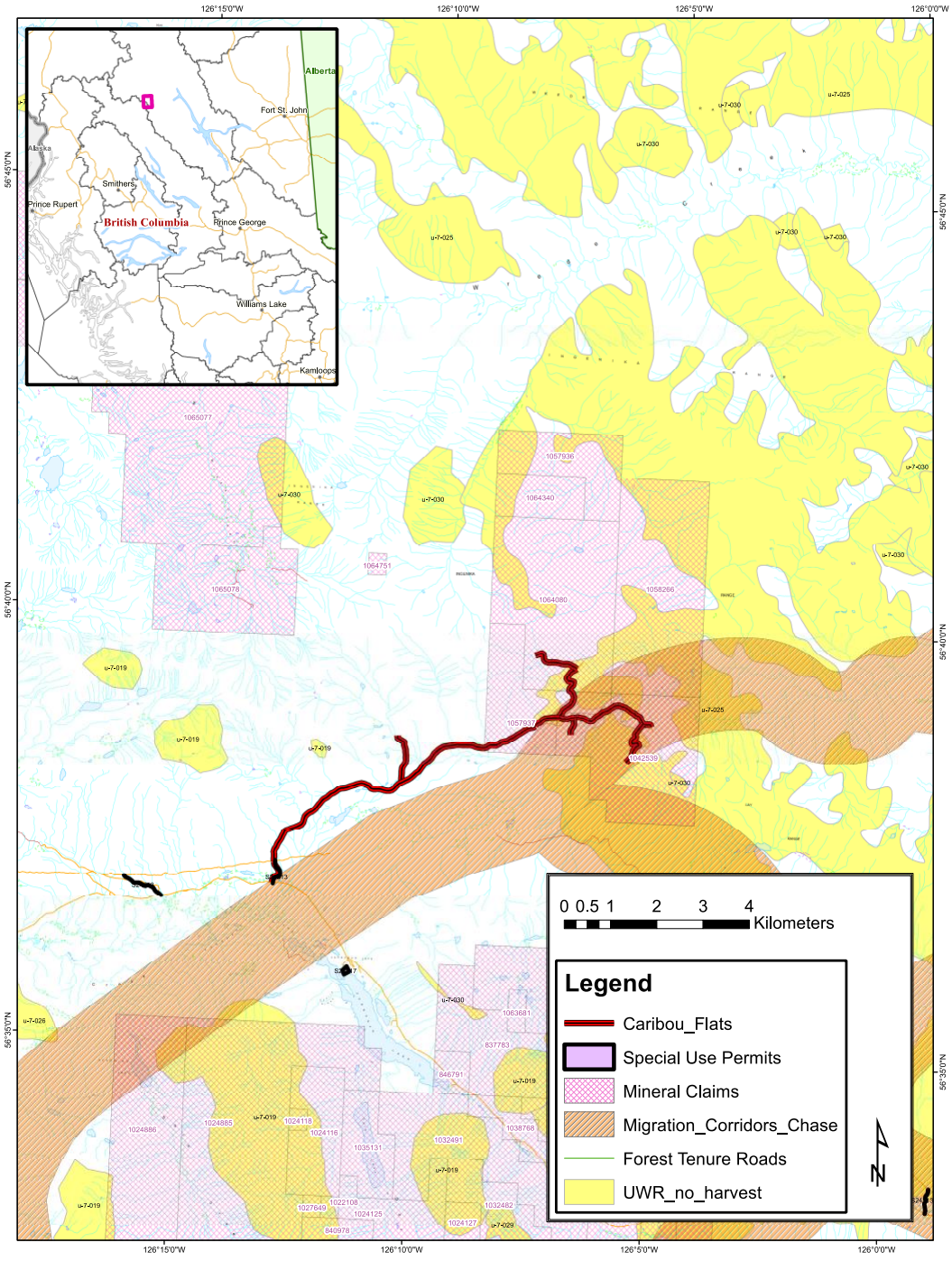


Figure 2. The Caribou Flats roadway & caribou migration corridors, UWR, No Harvest zones, & mineral claims

2 Methods

2.1 Study Area

The study area is located within the Omineca Mountains of north central British Columbia. The Chase caribou herd boundary is 12,465 km^2, and includes four major watersheds (Ingenika, Mesilinka, Osilinka, and Omineca Rivers). Low elevation forests (675-1300 m) contain lodgepole pine (*Pinus contorta*), white spruce (*Picea glauca*) and subalpine fir (*Abies lasiocarpa*). Mid-elevation forests (1300-1600 m) contain Engelmann spruce (*Picea engelmannii*) and subalpine fir, with some pine lichen stands.

The Caribou Flats roadway is located 165 km south west of Tsay Keh Dene, BC, 422 km northeast of Smithers, BC, and 475 km northwest of Mackenzie, BC. The location of the Caribou Flats road is shown in Figure 1 and Figure 2. It is a non-status road and is approximately 1.8 km north of Johanson Lake. A non-status road is one which has not been deactivated and is not managed by any resource agency or licensee. The road point of commencement is at 95.5 km on the Tenikihi Forest Service Road (latitude: 56.615314, longitude: –126.215427), and is 15.78 km in length. The road travels from low to high elevation, in a northeast direction, for 8.18 km, where it branches into sections that are 2.55 km, 3.94 km and 1.11 km in length, respectively. The Caribou Flats road extends from 1400 m to 1600 m in elevation.

The Chase caribou utilize different elevations throughout the year. In the post-rut period, high elevation range is typically used, while lower elevation pine/lichen forests or high elevation wind swept ridges are sought in winter. In early May to mid-June, the Chase move to high elevation calving grounds (Wood & Terry, 1999).

The dominant biogeoclimatic subzone of the study area is Spruce-Willow-Birch (SWBmk). White spruce is the most common species at lower elevations, with subalpine fir becoming dominant at higher elevations. Lodgepole pine and trembling aspen (*Populus tremuloides*) can be found on lower slopes and valley bottoms. Deciduous shrubs are able to thrive in high elevation areas of this zone. Scrub birch (*Betula glandulosa*) are abundant, and a suite of willow species (*Salix* spp.) are common. The SWBmk zone has the coldest climate of all the forested zones in British Columbia, second only to the Alpine Tundra zone (BC Ministry of Forests, 1991; Delong, 2004). The region supports large mammal species including the species of interest: caribou and their predators, grey wolves (*Canis lupus*), black bear (*Ursus americanus*), grizzly bear (*Ursus arctos*) and wolverines (*Gulo gulo*), in addition to alternative prey species such as moose (*Alces americanus*) (Delong, 2004). Figure 3 shows an image of the Caribou Flats roadway as it travels from mid to high elevation.

Figure 3. A section of the Caribou Flats roadway as it travels to high elevation caribou habitat.

2.2 Road Restoration and Monitoring

In May 2019, referral packages were sent out to the mineral tenure holders, guide outfitters, trapline licensees, First Nations, and Centerra Gold for consultation. The first 600 m of the Caribou Flats roadway was determined to be under special use permit to Centerra Gold, to access the power line for maintenance. This section of the road was not considered for restoration.

Between June 8-11 and July 11-15, 2019, CCE crews visited the Caribou Flats roadway to collect detailed site-specific information for development of a restoration prescription, and to deploy wildlife camera-traps and establish permanent vegetation plots as part of the monitoring program. The data collected was used to draft the road restoration prescription, monitoring prescription, as well as apply for necessary permits. Two permits were required for the restoration work, one to authorize working in and about streams, and the second to authorize destruction of crown timber (see Appendix 1).

The entire length of the roadway was surveyed and detailed information was collected during the initial visit in June 2019. The data tabulation included road width, slope, aspect, elevation, availability of trees for functional restoration, the presence of riparian features such as streams and creeks, culverts and bridges, and surrounding vegetation species.

Appendix 2 shows the data form used to collect prescription information. The final road restoration prescription is outlined below.

2.3 Road Restoration Prescription

Table 1. Project Identification

PROJECT IDENTIFICATION				
TSA	Forest District	Tenure Holder(s)	Location (Lat., Long.)	Map
Mackenzie	Mackenzie Natural Resource District; Stuart Nechako Natural Resource District	Mineral tenures: 1064080, 1057937, 1042539.	56.615314,-126.215427	See Appendix 1 (overview map) and 2 (detailed map).
Geographic Location	The road is a non-status road, and is approximately 1.8 km north of Johanson Lake. The road point of commencement is at 95.5 km on the Tenikihi Forest Service Road (latitude: 56.615314, longitude: -126.215427), and is 15.78 km in length. The road continues from mid (1400 m) to high elevation (1600 m) to the northeast for 8.18 km, where it branches into sections that are 2.55 km, 3.94 km and 1.11 km in length, respectively.			
Road Permit(s)	Client Name(s)		Total Length (m)	Total Area (ha)
Non-status road	Chu Cho Environmental LLP.		15,780	47,388

Table 2. Forest Stewardship Plan Identification

FSP IDENTIFICATION				
Applicable TU(s)	FSP ID	FSP Name	Effective Date	Expiry Date
NA	NA	The Caribou Flats forest road is considered to be outside of the timber harvest land base (THLB). The forest licensees have no obligations on this roadway, nor is it needed for access to future timber supply. A status check was completed for this roadway by the Ministry of Forests, Lands, Natural Resource Operations and Rural Development, and it was confirmed that outside of the mineral tenure, it is a non-tenured road.	NA	NA
Applicable FDU(s)	NA			

Table 3. Project Objectives

PROJECT OBJECTIVES
The purpose of this Road Restoration Prescription is to outline the Line Segments on the Caribou Flats road that will be restored. The Recovery Strategy for the Southern Mountain population of Woodland caribou in Canada provides the following recommendation: “Undertake coordinated actions to reclaim southern mountain caribou habitat in all currently utilized seasonal ranges through restoration efforts (e.g. restore industrial landscape features such as roads, old seismic lines, pipelines, cut-lines, temporary roads, cleared areas; reconnect fragmented annual ranges) to make it less suitable for other prey species.” The objective of this project is to restore the forest roadway located at Caribou Flats. Our project team seeks to make this road network less suitable for alternative prey species, predator travel, and enhance caribou seasonal range for the Chase caribou – an objective that aligns directly with the Federal Recovery Strategy goals for southern mountain caribou. Our project team will restore the Caribou Flats forest roadway using both Functional and Ecological restoration techniques.

Table 4. Glossary of Terms

GLOSSARY
Access Management – The physical objective of making a road or area impassable to motor vehicles (other than all-terrain vehicles), which is expected to protect the road from further compaction, protect planted trees, while simultaneously enabling environmental recovery. Barriers will include, but is not limited to the creation of debris berms in a clearly visible manner. Ecological restoration - Returning a road or other linear feature to its pre-disturbance composition and structural state. Functional restoration- Recovering chosen indicators of ecosystem health are the target over returning to the historic composition and structure of the landscape. Mechanical Site Preparation (MSP) – The physical work to alter soil conditions to favour the establishment, growth and survival of tree species, browse or another target vegetation. In this prescription, MSP includes soil ripping. Slash Rollback – Refers to the spreading of soil piles or vegetative debris with machinery, often left over from the timber harvest or road building activities, to cover targeted areas of linear disturbance. Slash rollback may be used to hinder vehicle access into and along the roadway, slow predator travel, and shelter tree and vegetation seedlings for optimal regrowth. Road Ripping – This treatment involves de-compacting the road surface and adjacent areas, with the goal of enhancing subsurface water infiltration by reducing soil bulk density and increasing surface infiltration. Machine Screefing – Road bed is disturbed with machine to reduce compaction, by moving rock, soil and woody debris. Timber Harvesting Land Base – The portion of the Crown forest land base that is available for timber harvesting. Tree Felling – Strategic tree felling uses chainsaws to lay trees across the road surface from alternating opposite directions; unlike ‘bending’ or ‘hinging’ trees in which trees are left hanging above the ground surface, tree felling allows the trees to fall to the ground. Line Segments (LS) – The area to which Functional and Ecological restoration will be applied. Tree planting – The process of transplanting tree seedlings, generally for forestry, land reclamation, or landscaping purposes.

Table 5. Mechanical Site Preparation Objectives.

MECHANICAL SITE PREPARATION OBJECTIVES
The intent of MSP is to alter soil conditions and create micro sites for summer planting. MSP treatments are expected to enhance the establishment, growth and survival of tree species or other target vegetation. Road Ripping and Access Management are two types of MSP treatments that will be applied to select Line Segments. MSP treatments are expected to improve soil infiltration capacity, reduce soil bulk density, while also creating a more favourable seed bed that will accelerate the return of the road to a mature forest environment. More rapid forest regeneration is expected to help overcome limiting factors for the Threatened southern mountain caribou. Specifically, the MSP techniques in this prescription target the following guiding principles to benefit caribou: • Maintain connectivity within and between caribou ranges. • Limit motor vehicle access to the road, thus facilitating natural regeneration along the roadway. • Alter microsite conditions so that it accelerates seedling growth and creates a more favourable site for seed rain to establish and grow. MSP will be achieved with the following techniques: • Road Ripping applied at a depth of 30 cm using a 336D CAT Excavator and a Ripper Tooth • Machine Screefing using a 336D CAT Excavator with an excavator bucket • Slash Rollback using a 336D CAT Excavator with an excavator bucket • Access Management using a 336D CAT Excavator with an excavator bucket

Table 6. Silviculture Objectives

SILVICULTURE OBJECTIVES
The intent of Tree Planting treatments is to accelerate the return of the road to a mature forested environment, thus returning the road to its pre-disturbance composition and structural state. The reference guide (and Updated) for FDP Stocking Standards (2014): Climate-Change Related Stocking Standards will be followed, and all Tree Planting treatments will be preceded by MSP with the goal of creating an appropriate seedbed for the establishment of coniferous and deciduous seedlings.

Table 7. Functional Restoration Objectives

FUNCTIONAL RESTORATION OBJECTIVES
The objective for Functional Restoration is to recover chosen indicators of ecosystem health, rather than returning to the historic composition of the landscape. The Functional Restoration component of the Caribou Flats restoration will use mechanical intervention to restore historic caribou-predator encounter rates. Reducing predator-access to caribou (including the access of humans into caribou habitat) limits disturbance, which can compromise individual fitness, as well as limit direct mortality of caribou. The interventions presented in this prescription for the Caribou Flats road restoration will result in: • Controlled access to road surface(s) to manage human access and promote natural revegetation. • Decreased line-of-sight within the linear feature(s) to create refuge for caribou from predators and create visual barriers to obscure caribou. Decreased predator travel-speed through altered the road surface as to impede predator ease-of-travel along the road surface. Functional restoration of roads for caribou can in turn protect overall ecological integrity as decreased tread, by foot or tire, in turn facilitates more rapid forest regeneration. Ultimately, the goal is to create a landscape that has been functionally restored that can support self-sustaining caribou populations. Functional Restoration will be achieved by implementing the following techniques: • The application of Tree Felling treatments. • Slash Rollback treatment will be applied

Table 8. Site Characteristics

SITE CHARACTERISTICS										
Site						Soils				Vegetation
TU	BEC	Elevation (m)	Road Grade (%)	Side Slope Grade South %	Side Slope Grade North %	Aspect	Soil Texture	Coarse Frag. (%)	Organic Materials	Genera
1	AT	1678	-0.075	-37	35	E	Coarse	75	None	*Abies*
2	SWBmk	1526	0.6	-20	12	SE	Coarse	51	None	*Abies, Salix, Picea, Pinus*
3	SWBmk	1451	-0.025	27	-15	SSE	Coarse	75	None	*Abies, Pinus, Salx*
4	SWBmk	1523	10.2	-20	8.4	SE	Coarse	75	None	*Abies, Salix, Pinus*
5	SWBmk	1582	6.2	-18	11	E	Coarse	75	None	*Abies, Salix*
6	AT	1592	-4	4	-4	E	Fines	10	1 cm	*Abies*
7	SWBmk	1515	-17.5	-14	7	S	Coarse	75	None	*Abies, Picea, Pinus, Salix*

Table 9. Treatment Summary

TREATMENT										
									Planting	
Line Segments	Treatment Regime	POC (Lat.,Long.)	POT (Lat., Long.)	Length (m)	Road Width (m)	Area (ha)	Drainage Structures	Riparian Features	Species	SPH
1	None	56.660057, -126.1117	56.656495, -126.118	575	3.7	.213	0	3	NA	NA
2	Tree Felling	56.656495, -126.118	56.652521, -126.14461	3,000	2.9	.87	0	9	NA	NA
3	Tree Felling	56.648518, -126.11861	NA	1,000	3.9	.39	0	1	NA	NA
4	Access Management, Mechanical Site Preparation (Machine Ripping, Machine Screefing, Slash Rollback), Tree Felling, Tree Planting	56.642332, -126.1486	56.639667, -126.16433	1,100	2.8	.308	1	5	*Picea glauca, Betula glandulosa* (66/33)	437

5	Mechanical Site Preparation, Tree Planting	56.639667, -126.16433	56.622314, -126.21626	4,100	3.1	1.271	1	8	*Picea glauca, Betula glandulosa* (66/33)	437
6	None	56.637067, -126.17426	NA	1,000	1.5	.15	0	0	NA	NA
7	Access Management, Mechanical Site Preparation (Machine Ripping, Machine Screefing, Slash Rollback), Tree Felling, Tree Planting	56.622314, -126.21626	56.61892603, -126.217773	400	4.1	.164	1	1	*Picea glauca, Betula glandulosa* (66/33)	437
Total				11,175		3.366	3	27		

[2] Acronyms are as follows: Meters = m, Point of Commencement = POC, Point of Termination = POT, Stems Per Hectare = SPH

[3] A map of these treatment is provided in Appendix 3.

Table 10. Comments.

COMMENTS	
TU	Notes
1	No treatment applied. Within mineral tenure holder boundary (no MSP) and no mature trees available for Tree Felling.
2	Tree felling can commence, as there are mature trees available for Tree Felling.
3	A deactivation is currently in place at the TU point of commencement. Tree Felling crews will need to travel by foot.
4	Outside of mineral tenure boundary, and machine work can commence.
5	Near alpine area, and no trees or debris available for Tree Felling or Slash Rollback.
6	Machine free zone. No activity permitted within this area as the line segment is vegetated by a sensitive alpine plant community.
7	Overhead wires present along hydro line corridor. Access Management treatments to be applied intensively.

Table 11. Summary Of Values and Rights To Be Considered.

VALUES – RESULTS & STRATEGIES			
Result/ Strategy/ Measure	Act/ Reg.	Applicable	How it Applies to the Site
Landscape Biodiversity	FPPR sec. 9 and 14	N	This prescription does not include forest harvest, cutblock design, road construction, or any other activities typically associated for forestry practices in British Columbia.
Soils	FPPR sec. 5, 12.2, 35 and 36	Y	This prescription does not include forest harvest, cutblock design, road construction, or any other activities typically associated for forestry practices in British Columbia, and is consistent with FPPR sections 5, 12.2, 35 and 36. Areas of compacted soil will be rehabilitated in identified TUs, to improve productivity and the hydrologic function of the soil. Treatments will include de-compaction, returning displaced surface soils, retrieving side-cast and berm materials, and recontouring. These activities will occur in a way that does not allow sediment to enter a stream, wetland or lake. Woody debris will be placed on exposed soil, and the area reforested at 1,200 SPH to reduce the likelihood of erosion.
Wildlife and Species at Risk	FPPR sec. 7 FRPA U-7-025 British Columbia Wildlife Act - Section 34 Federal Migratory Birds Convention Act - Section 5(9)	Y	This prescription does not include forest harvest, cutblock design, road construction, or any other activities typically associated for forestry practices in British Columbia. The Caribou Flats road intersects the Mackenzie Timber Supply Areas Northern Caribou High Elevation Winter Range - Ungulate Winter Range – Core Area – Unit No: 61- Chase herd. The Chase herd of caribou is considered to be Southern Mountain Caribou by the Federal Government, a Threatened Species in Canada. This work will be completed in the July 16 – September Low Risk timing window for Northern Caribou.

			In compliance with the BC Wildlife Act and Migratory Birds Convention Act, pre work bird nest surveys will be completed. The road does not intersect or run adjacent to a Wildlife Habitat Area, General Wildlife Measure, Wildlife Habitat Feature. The road does intersect Ungulate Winter Range for Caribou and Stone Sheep.
Northern Caribou Ungulate Winter Range	FRPA U-7-025	Y	The Caribou Flats road intersect the Mackenzie Timber Supply Areas Northern Caribou High Elevation Winter Range – Ungulate Winter Range Core Area – Unit No: 61 – Chase herd. This work will be completed in the July 16 – September Low Risk timing window for Northern caribou.
Stone Sheep Ungulate Winter Range	FRPA U-7-028	Y	The Caribou Flats road intersects the Mackenzie Timber Supply Areas Stone's Sheep Ungulate Winter Range – Specified Area – Unit No: SA3
Mountain Goat Winter Range	FRPA U-7-030	N	The Caribou Flats road does not intersect or run adjacent to Mountain Goat Ungulate Winter Range.
Water, Fish, Wildlife and Biodiversity within Riparian Areas: General	FPPR secs. 8, 12.3(1) to (5) and (7)	Y	This prescription does not include forest harvest, cutblock design, road construction, or any other activities typically associated for forestry practices in British Columbia. The road restoration prescription will be carried out, and all streams crossings conducted in accordance with the water Sustainability Act, Section 11 permit approved by a Habitat Officer with the Ministry of Forests, Lands, Natural Resource Operations and Rural Development under the Water Sustainability Act with the Omenica Region on Thursday, July 4, 2019.
Water, Fish, Wildlife and Biodiversity within Riparian Areas: Retention of Trees in Riparian Management Zones	FPPR secs. 8, 12.3(3) and (6)	N	This prescription does not include forest harvest, cutblock design, road construction, or any other activities typically associated for forestry practices in British Columbia.
Wildlife and Biodiversity – Landscape Level	FPPR secs. 9 and 12.4	N	This prescription does not include forest harvest, cutblock design, road construction, or any other

			activities typically associated for forestry practices in British Columbia.
Wildlife and Biodiversity – Stand Level	FPPR secs. 9.1 and 12.5(1)	N	This prescription does not include forest harvest, cutblock design, road construction, or any other activities typically associated for forestry practices in British Columbia.
Retention Areas May Apply to More Than One Cutblock	FPPR secs. 9.1 and 12.5(1)	N	This prescription does not include forest harvest, cutblock design, road construction, or any other activities typically associated for forestry practices in British Columbia.
Restriction on Harvesting Wildlife Tree Retention Areas	FPPR secs. 9.1 and 12.5(2)	N	This prescription does not include forest harvest, cutblock design, road construction, or any other activities typically associated for forestry practices in British Columbia.
Visual Quality	GAR sec. 7(2) and FPPR sec. 12(7)	N	This prescription does not include forest harvest, cutblock design, road construction, or any other activities typically associated for forestry practices in British Columbia.
Cultural Heritage	FPPR sec. 10	N	This restoration plan is consistent with FPPR Sec. 10. First Nation consultation was led by the Mackenzie District of the Ministry of Forests, Lands, Natural Resource Operations and Rural Development. Consultation was initiated at the notification level for the Caribou Flats road restoration on May 10, 2019, and ended on May 31, 2019. No questions or concerns have been raised relating to this project by First Nations during this process.
Agricultural Development Areas and Settlement Reserve Areas	Land Act sec. 93.4	N	The Caribou Flats road restoration prescription does not include lands identified under the Land Act sec. 93.4.
Recreation Site, Recreation Trail or Interpretive Forest Site	FRPA sec. 181	N	This restoration prescription is consistent with FPPR sec. 181 and does not impact areas established or continued under this code. This prescription does not include forest harvest, cutblock design, road construction, or any other activities typically associated for forestry practices in British Columbia.
Invasive Plants	FPPR sec. 17	Y	The Caribou Flats road restoration will be carried out in accordance with FPPR sec. 17. The presence of plants that are invasive plants under the Invasive Plants Regulation, will be documented, and the presence will be communicated to the British Columbia Ministry of

			Forests, Lands, Natural Resource Operations and Rural Development Regional Invasive Plant Specialist.
Natural Range Barriers	FPPR sec. 18	N	This restoration prescription is consistent with FPPR sec. 18. Additional management considerations are outlined below.

OTHER MANAGEMENT REQUIREMENTS

Species at Risk Databases and Special Notes

The Chase caribou is considered by the Federal government of Canada to be part of the Southern Mountain population of woodland caribou, which is listed on Schedule 1 of the Federal Species at Risk Act as 'Threatened.' The Caribou Flats road is adjacent to, and extends into, an identified migration corridor for the chase caribou. In addition to this, the road overlaps with the Ungulate Winter Range in the no harvest zone. The Recovery Strategy for the Southern Mountain population of caribou (Rangifer tarandus caribou) in Canada has identified that "the range of the Southern Mountain Population has shrunk by up to 40% and 13 of 19 herds are declining." These herds are "threatened by decreasing habitat quantity and quality, harassment, and predation." If steps are not taken, the Southern Mountain population could become endangered.

The Federal Recovery Strategy for the Southern Mountain caribou provides the following recommendation: "Undertake coordinated actions to reclaim southern mountain caribou habitat in all currently utilized seasonal ranges through restoration efforts (e.g., restore industrial landscape features such as roads, old seismic lines, pipelines, cut-lines, temporary roads, cleared areas; reconnect fragmented annual ranges) to make it less suitable for other prey species."

Our project team now seeks to restore the Caribou Flats Road and make this road network less suitable for alternative prey species, predator travel, and enhance caribou seasonal range. This aligns with the Federal Recovery goals for the southern mountain caribou.
This road restoration prescription does not include any known occurrences of species at risk other than caribou.

First Nations

The restoration of the Caribou Flats roadway was initiated by Tsay Keh Dene Nation. First Nation consultation was led by the Mackenzie District of the Ministry of Forests, Lands, Natural Resource Operations and Rural Development. Consultation was initiated at the notification level for the Caribou Flats road restoration on May 10, 2019, and ended on May 31, 2019. No questions or concerns have been raised relating to this project by First Nations during this process.

Mineral Tenure Holders/Guide Outfitters/ Special Use Permit Holders

The impacted Mineral Tenure Holders, Guide Outfitters and Special Use Permit Holders were notified in May and June 2019 of the intent to restore the Caribou Flats roadways by Chu Cho Environmental LLP and the British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development. All respondents were in support of this project. There is a Special Use Permit on the first 600 m of the Caribou Flats Roadway. This Special Use Permit Holder requires access to the first 575 m of the Caribou Flats road in order to carry out brushing and maintenance of the powerline right-of-way. So as to not impact this requirement of permit holder, restoration activities will commence at the 575 m mark of the Caribou Flats road.

Permitting Requirements

The road restoration prescription will be carried out, and all streams crossings conducted in accordance with the water Sustainability Act, Section 11 permit approved by a Habitat Officer with the Ministry of Forests, Lands, Natural Resource Operations and Rural Development under the Water Sustainability Act with the Omenica Region on Thursday, July 4, 2019.

Under the Section 52 (1)(b) of the Forest and Range Practices Act, the Ministry of Forests, Lands, Natural Resource Operations and Rural Development has approved our request to cut, damage and/or destroy Crown timber for caribou habitat restoration purposes on the non-status Caribou Flats road to the extent described in the permit.

A copy of both permits will be retained on site during works by the Qualified Professional that is acting as the onsite project manager.

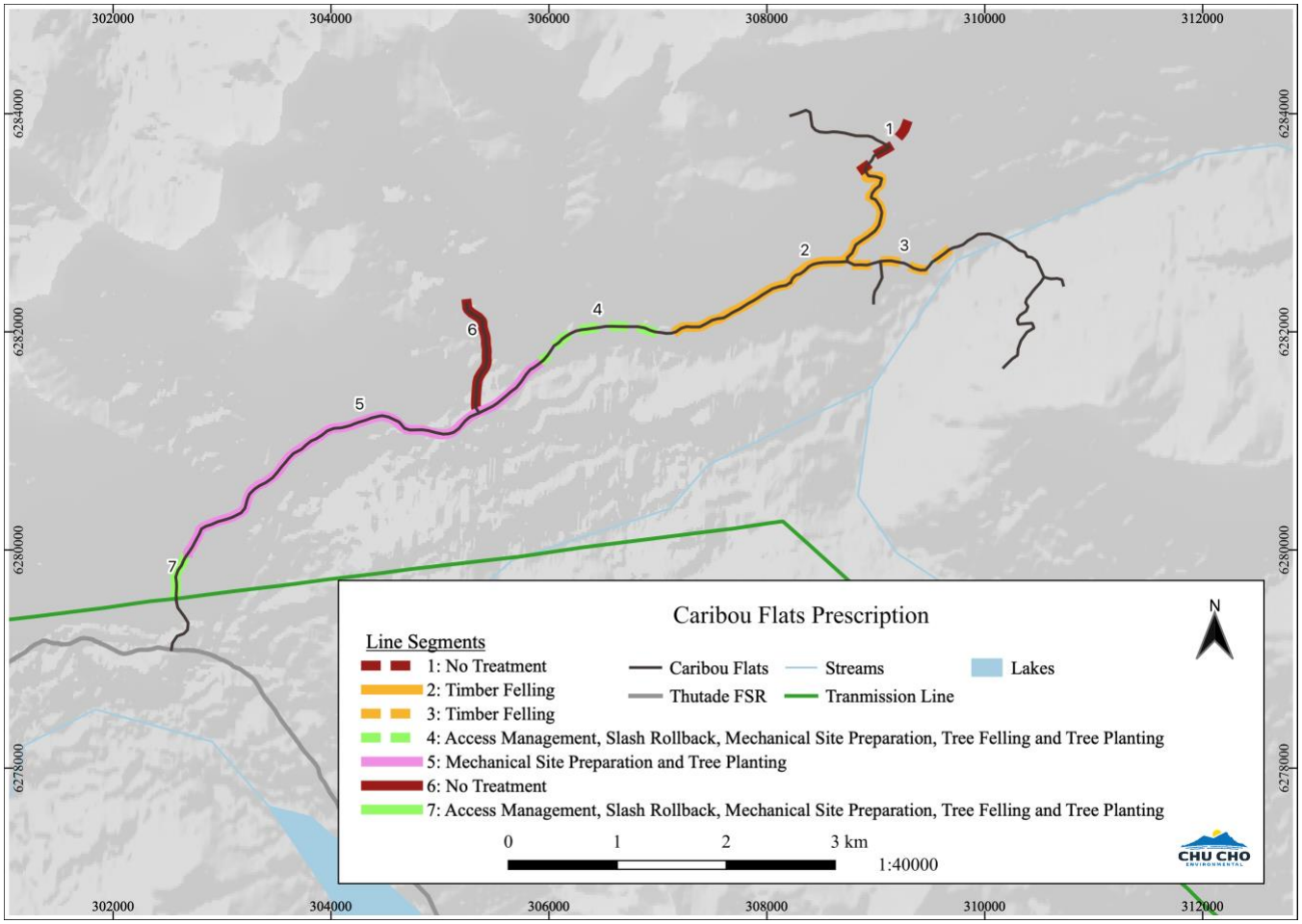


Figure 4. Summary of Restoration Prescription Treatment Line Segments.

2.4 Monitoring Program

Pre-restoration field data was collected between July 11-16 2019 to provide a baseline reference for post-implementation monitoring. The monitoring program had 4 main objectives:

1. Assess how wildlife (in particular caribou and their predators) distribute themselves in time and space, pre- and post-implementation of both functional and ecological restoration. Camera-traps are considered to be an effective tool to evaluate and compare multi-species interactions and distributions along linear features under different conditions (Keim et al. 2019).

2. Evaluate the assumption that restoration increases preferred vegetation for caribou. Vegetation surveys are a form of effectiveness-monitoring, and can indicate if the treatment is providing a desired response and rate (Golder Associates 2015).

3. Evaluate the assumption that linear feature restoration limits use of the corridor by predators and alternative prey. Wildlife surveying is a form of validation-monitoring, and can indicate whether the habitat restoration is effective (Golder Associates 2015).

4. Human activity can render a confounding factor to wildlife abundance and vegetation regrowth, hence understanding human activity levels is crucial to evaluating the effectiveness of the restoration procedures.

Pre-implementation field data and implementation of the project monitoring plan was conducted using the techniques outlined in Section 2.5.

2.5 Vegetation Surveys

Vegetation surveys were used to monitor woody plant succession and wildlife browsing of woody plants and trees. A total of 10 permanent vegetation survey sites were established along the Caribou Flats road, between July 11-15 2019. Each survey site had 2 sets of 3 plots each. Vegetation sites were paired, with one set of 3 plots established on the Caribou Flats road, and one set of 3 plots established in the adjacent forested area, as a reference site. Table 12 provides the locations of the vegetation sites and plots. The reference sites were established 25 m directly adjacent to the road. Vegetation sites were established in approximately 1 km increments; sites were >100 m from apparent biogeoclimatic zone shifts and optimally paired with wildlife cameras.

A vegetation survey site consisted of three permanent sub-plots of 1.78 m fixed-radii circular plots (10 m^2 each) located along a center line. The center of each sub-plot was marked with a metal pigtail stake, flagging tape, and aluminum tag affixed with the plot name, number, and date of establishment.

Table 12. Location of permanent vegetation plots for the monitoring program.

Vegetation Site	Plot Number	Latitude	Longitude
1	1	56.619813	-126.217746
	2	56.61976498	-126.217754
	3	56.61973103	-126.217746
	4	–	–
	5	–	–
	6	–	–
2	1	56.63027999	-126.202255
	2	56.63024898	-126.202277
	3	56.63020598	-126.202297
	4	56.63009802	-126.201857
	5	56.63005703	-126.201925
	6	56.630037	-126.202005
	1	56.63417699	-126.187093

3	2	56.63418403	-126.187162
	3	56.63422703	-126.187192
	4	56.63398404	-126.187347
	5	56.63398697	-126.18725
	6	56.63397096	-126.187153
4	1	56.63699297	-126.174197
	2	56.63703304	-126.17422
	3	56.63708601	-126.174235
	4	56.63690597	-126.174582
	5	56.63696003	-126.174583
	6	56.63697604	-126.174665
5	1	56.63564801	-126.171537
	2	56.63566402	-126.171469
	3	56.635703	-126.171449
	4	56.63545397	-126.171265
	5	56.63543897	-126.171326
	6	56.63541701	-126.171378
6	1	56.64260399	-126.152291
	2	56.64260499	-126.152364
	3	56.64258404	-126.152436
	4	56.64282301	-126.15246
	5	56.64284999	-126.152423
	6	56.64285896	-126.152342
7	1	56.64615003	-126.13139
	2	56.64611701	-126.131402
	3	56.646101	-126.131457
	4	56.64599002	-126.13102
	5	56.64595599	-126.131057
	6	56.64594702	-126.131169
8	1	56.648507	-126.107863
	2	56.64848498	-126.107916
	3	56.64846101	-126.107958
	4	56.64862798	-126.108429
	5	56.64866704	-126.108387
	6	56.64867701	-126.108328
9	1	56.65590799	-126.11557
	2	56.65591797	-126.115497
	3	56.65592702	-126.11541
	4	56.65608896	-126.115899
	5	56.65610103	-126.115814
	6	56.656124	-126.115739
10	1	56.65870897	-126.113741
	2	56.65866204	-126.113782
	3	56.65862298	-126.113822
	4	56.65874803	-126.114098

5	56.65874904	-126.114025
6	56.65876597	-126.113992

Vegetation surveys were completed on July 12, 13 and 14, 2019. Plots on the road were numbered from 1-3 and reference plots were numbered 4-6. Plot centers were oriented down the center of the road, with plot centers separated by 4 m. Reference Plots numbered Veg10-4, Veg10-5, Veg10-6.

The following data was collected from each plot:

- Density by tree species (live vs. dead)
- Species percent cover of woody shrubs and trees
- Height and leader growth by tree species
- Percent cover of herbaceous and graminoid layer
- Percent cover of lichens
- Percent cover of mosses
- Presence and cover of invasive/non-native plant species

Sampling protocols followed the ocular estimate protocols from the Ministry of Forests, Lands and Natural Resource Operations for vegetation - Field Manual for Describing Terrestrial Ecosystems – Land Management Handbook 25 (2nd ed.). Percent cover was estimated as the percentage of the ground surface covered when the crowns were projected vertically. For vegetation layers, small gaps that were not fully covered were ignored. Canopy structure data was recorded as A1, A2 or B1 by species. Low shrub was considered as the B2 layer, herb (C) and moss, lichen and liverwort considered as (D- cryptogram). Estimates of total percent cover were recorded as < 1%, in 1% increments from 1 – 10%, and in 5% increments for vegetation cover > 10%. Appendix 3 contains a list of equipment used during the establishment of vegetation plots.

In addition to the vegetation parameters, the following data was collected:

- Width of road (m)
- Line of sight measurement (m)
- Presence and level of ATV and vehicle traffic
- Presence and level of game trails/incidental wildlife sign
- Notes on any additional disturbance at site
- Slope and aspect

2.6 Camera-Traps

This study deployed motion-sensing cameras equipped with infrared flash to capture images during daylight, dusk, and night. Each camera was programmed to trigger with movement in the camera's detection zone. 3 Moultrie Cameras were deployed in June 2019, and 15 Cameras were deployed on July 11, 2019. All cameras were set to take 5 photographs, with a 1 second between, when triggered. Motion sensitivity was set to high. Table 13 summarizes the locations of deployed camera-traps, and Figure 5 shows the locations of the cameras deployed. Appendix 3 lists the equipment used for the camera-trap portion of this project.

Table 13. Location of camera-traps along Caribou Flats road

Camera	Latitude	Longitude
1	56.619551	-126.21767
2	56.620976	-126.21756
3	56.63013	-126.20233
4	56.634114	-126.18692
5	56.633966	-126.17645
6	56.637051	-126.17407
7	56.635471	-126.17165
8	56.639632	-126.16446
9	56.642607	-126.15197
10	56.646262	-126.13076
11	56.648564	-126.10784
12	56.648821	-126.12022
13	56.648911	-126.12039
14	56.655849	-126.11571
15	56.65855	-126.11384

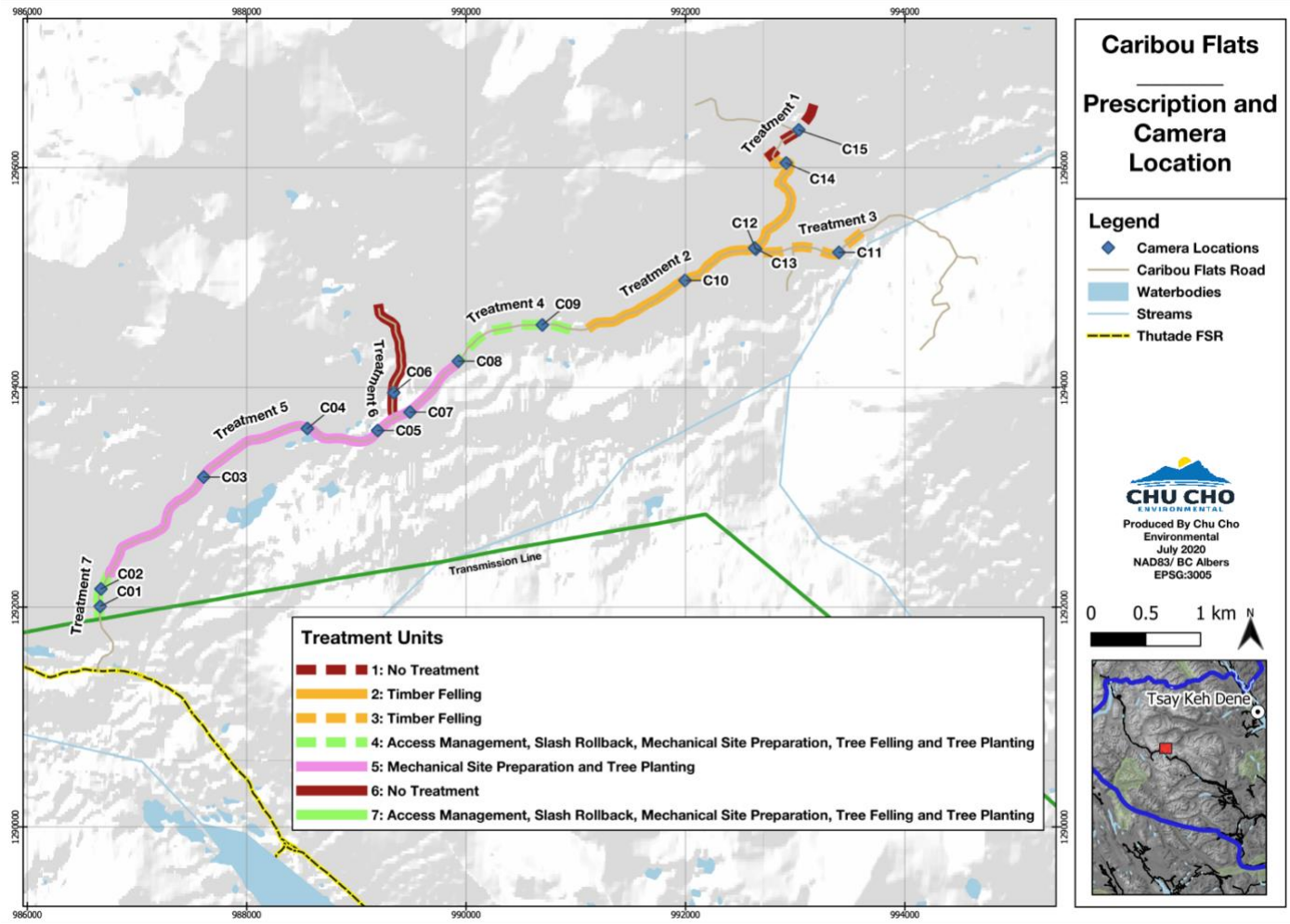


Figure 5. Location of wildlife monitoring cameras deployed at Caribou Flats

Roads and traffic have been shown to have significant effects, both positive and negative, on wildlife species abundance, especially in species with large movement ranges (Fahrig and Rytwinski 2009). The following principles were used to select camera placements along the Caribou Flats road:

- A total of 15 cameras were deployed throughout the Caribou Flats road habitat. A separation of 1 km for ten cameras was preferred, however, some flexibility in placement allowed for coinciding placement with high quality habitat documented during vegetation sampling or where there was an expectation for high probability to view caribou, moose, or their predators. Five cameras were strategically deployed in conjunction with access roads, intersections and converging locations.

- Cameras were installed at heights of >1.5 m, with a slight downward angle, to reliably capture images of wolves, bears, caribou and humans, while accounting for potential snow depth.

- Detection zones were limited to distances <20 m from the camera (Keim et al. 2019), typically ~4 m (equivalent to the width of the corridor, if installed perpendicular) or ~15 m (if positioned on a diagonal to the alignment of the feature).

- For mitigation/treatment-placed cameras, mitigation was ceased for a minimum of 15 m beyond the viewpoint of the cameras. Near the permanent roadway, aiming camera view down the right of was expected to affect battery drainage from traffic on the permanent road surfaces (Keim et al. 2019).

- Once installed, infrared cameras were set to record one image every second for 5 seconds when triggered, and then immediately rearm. This ensured all individuals would be detected when a group of animals moved through the detection area (Keim et al. 2019).

2.7 Nest Surveys

The disturbance or destruction of a bird, its nest or its eggs is prohibited under Section 34 of the British Columbia *Wildlife Act* and Section 5(9) of the federal *Migratory Birds Convention Act, 1994* (MBCA). Further, the *Species at Risk Act* (SARA) provides similar protection for species listed as *at-risk* on Schedule 1, regardless of whether they are protected by the *Wildlife Act* or MBCA. In order to comply with these legislations, pre-work surveys were necessary when industrial activities involved vegetation clearing or similar habitat alteration.

The nest survey protocol used was based on the methods developed by Manning et al. (2015) for a large-scale development in the Peace Region of British Columbia. Nest detection was difficult as nest placement is purposefully cryptic for most bird species. As such, survey efforts were methodical and paced to detect bird behaviours. Survey effort did not exceed 1 ha/hr, although terrain, forest type and surveyor experience may have made actual survey time faster.

Nest surveys were conducted by walking along transects through the survey area, which were defined as the areas to be altered through the rehabilitation process (i.e., forest at roadway edge). The roadway had minimal ground cover and was considered unlikely to contain any bird nests; as such, it was unnecessary for crews to survey the roadway. Nest surveys were only conducted along sections of roadway that were receiving the tree felling treatment. This included treatment units (LS) 2, 3, 4, and 7, totaling 5.5 km of roadway.

Using a georeferenced map, crews plotted survey transects along the length of the tree felling treatment sections. Transects were run parallel to the roadway and ran the entire length of the area in which habitat alteration (i.e., tree felling) would occur. Transects covered a 5 m wide search area (i.e., 2.5 m on either side of transect line) in the vegetated habitat on either side of the road. Figure 6 shows the transect layout used during nest surveys. Surveyors walked the transects and visually scanned the search area for nests and signs of nesting activity. Surveyors worked in crews of two, walking parallel transects on either side of the road.

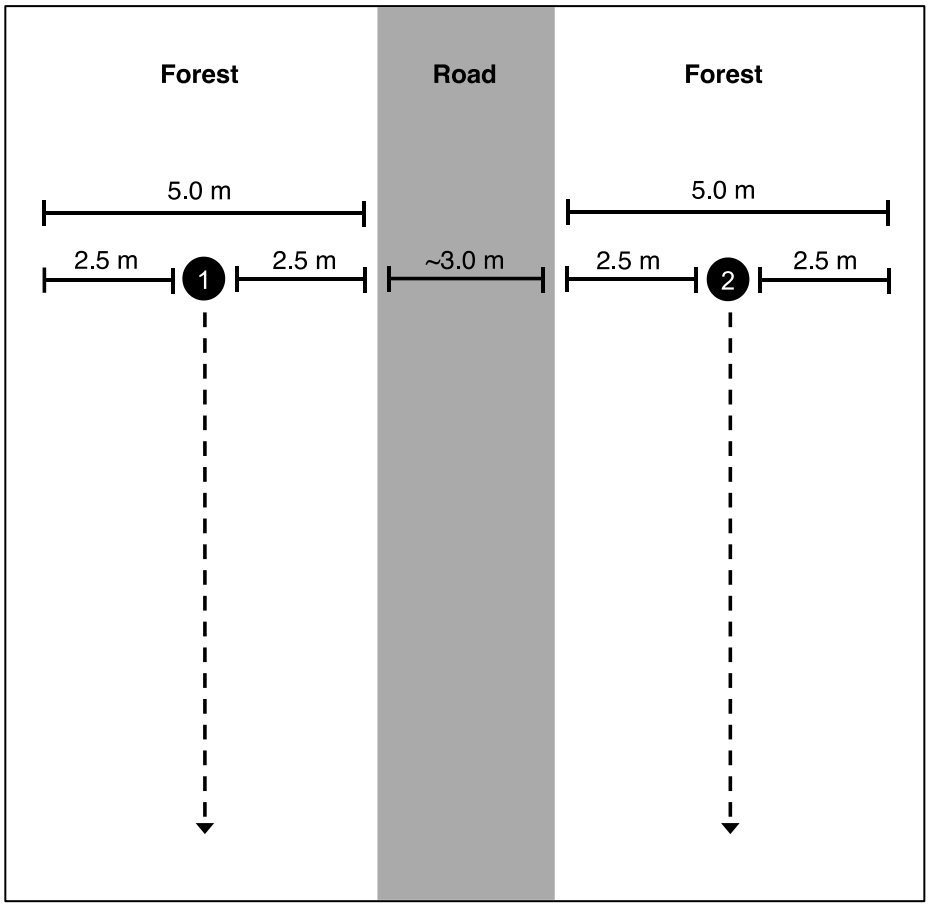


Figure 6. Nest survey transect layout. Surveyors will work in crews of two, with surveyors walking parallel transects on either side of the road.

Except for large stick nests and cavity nest, a physical nest was unlikely to be detected. Instead, adult behaviour was the primary indicator of an active nest nearby. Example behaviours indicative of an active nest nearby included, adult flushing from nest, adult carrying nesting material, adults bringing food to the nest, adults carrying fecal sacs away from the nest, adults giving alarm calls or exhibiting agitated behaviour (e.g., dive-bombing surveyor, bill snapping, fast movements through area), adults performing distraction displays (e.g., dive-bombing surveyor, injured wing displays), or the sound of young begging for food.

If a physical nest was detected, surveyors determined nest status (active vs. inactive), by observing the behaviour of adults in area, and observing nest condition (e.g., inactive: moss growing in nest cup; active: clean nest cup, or nest cup with visible eggs).

If evidence of an active nest was observed, the nest had to be buffered. The size of the buffer to be placed on an active nest was dependent primarily on species. Table 14 summarizes the minimum buffer size for most species the surveyors expected to encounter was 30 m.

Table 14. Recommended minimum buffer sizes around active bird nests (From Manning et al. 2015).

Bird Species or Guild	Recommended Buffer Size
Songbirds	30 m radius
Ground Nesters (e.g., grouse, Common Nighthawk)	30 m radius
Waterfowl and Shorebirds	30 m radius
Cavity Nesters (including cavity-nesting owls and raptors, and most woodpeckers/sapsuckers)	30 m radius
Pileated Woodpecker	50 m radius
Raptors and Owls (stick nesters/non-cavity nesters)	100 m radius
Bald Eagle, Golden Eagle, Osprey, Peregrine Falcon, Northern Goshawk, Trumpeter Swan, Sandhill Crane	200 m radius
Great Blue Heron	300 m radius

The approximate location of any active bird nest found was flagged using blue flagging tape. The 4-letter code of the nesting species (if known) and unique nest number would be written on the flagging tape. In addition, general directions to the nest from the marked point would be written on the flagging tape (direction, distance, height, etc.).

The surrounding nest buffer would be flagged using pink flagging tape. The buffer would be visible from a distance to approaching crews can so they could plan their habitat alteration activity appropriately. Habitat alteration could not occur within the buffer of an active nest.

During the critical nesting period, it was insufficient to conduct a single nest survey as nests may be at different stages, some that are more easily detected than other. For example, adults building a nest, or provisioning young, will be more easily detected than an adult that is incubating eggs. In addition, during this period, new birds could have arrived on the breeding grounds and initiated nesting daily. To account for these factors, two repeated nest surveys were completed over 2 consecutive days, in the areas scheduled for treatment.

2.8 Treatment

Functional and ecological restoration treatments were completed on the Caribou Flats roadway between July 17-24 2019. Chu Cho Industries was contracted to perform the tree-felling and hinging, slash rollback, and site prep work. A CAT 336D excavator with ripper tooth attachment was used for the site preparation and decompaction of the road surface.

Following the completion of two consecutive days of nest surveys, the area was designated 'free to clear' (excluding identified nest buffers) for 3 days, indicating that tree felling was permitted to occur in the surveyed area. If more than 3 days were required to complete the alteration activity in the surveyed area, a single nest survey would be completed following the first 3-day 'free to clear' period, and within 5 days of the last nest survey, to initiate a second 3-day 'free to clear' period.

Nest surveys were conducted on July 17 and 18,2019, and tree felling was completed in LS 2, 3 and 4, within the 'free to clear' period between July 19 and 21, 2019. Figure 7 shows trees being felled in LS 2. Site prep in LS 5 and 7 commenced on July 19, 2019 and was completed on July 24, 2019. Additional nest surveys were conducted on July 22 and 23, 2019 to clear LS 7 for site preparation and tree felling. Access control was implemented at the power line end of LS 7 to prevent any future vehicle access to the roadway. Figure 8 shows a loosened road surface site prepped for future tree planting in line segment 5.

To complete the site preparation, in LS5, the tracked machine had to ford several waterways. Fording the creeks was decided as the best way to cross since it was for limited one-time access, and no other practical options existed. Crews followed the best management practices for ford stream crossings in the Omineca region and worked within the reduced risk regional timing windows for fish and wildlife (Ministry of Forests, Lands and Natural Resource Operations, 2013). Effort was made to minimize heavy equipment crossing the creeks multiple times.

At the start of the Caribou Flats roadway (end of LS 7), 2 large pits were excavated, approximately 5 m deep across the roadway. These pits were blocked off with dead snags to prevent any attempts at crossing the pits with an ATV or vehicle. This access control measure was located in a way that access around the side of the pits was also not possible. Figure 9 and Figure 10 show the access control at the power line to prevent vehicles using the Caribou Flats roadway.

Permits required for the work included Sec 52 – damaging crown timber, and Sec 11 – in-stream works. All activities were carried out within the scope of these permits. Copies of these permits are in Appendix 1 – Permits.

All treatment planting activities, include the planting of 1600 white spruce and 800 scrub birch, were completed August 25 and 26, 2020. The SD cards from 14/15 trap cameras were also collected at this time. 1/15 cameras was missing at the time of retrieval.

Figure 7. Functional restoration tree felling in LS 2

Figure 8. Site preparation for tree planting in Line Segment 5

Figure 9. Access control ditch at the start of the Caribou Flats roadway.

Figure 10. Final access control measures at the start of the Caribou Flats roadway.

3 Conclusion

Functional and ecological restoration was completed on the Caribou Flats roadway in 2019 and 2020. A road restoration prescription was developed, 20 permanent vegetation survey plots were established and monitored, and 15 camera traps were deployed. The vegetation plots and camera-traps were intended to provide baseline data for future monitoring work, to measure the long-term efficacy of the habitat restoration.

Studies have shown that caribou-wolf encounters increase near linear features and that wolves were more likely to use linear features, especially near high elevation area used by caribou (Whittington et. al. 2011). The purpose of functional restoration was to make travel along the roadway more difficult for predators of caribou, and vehicles. Reducing road useability can in turn reduce predation pressure and stress on caribou and other prey species (Latham et. al 2011). Felling and hinging trees disrupts the line of sight along the road and can help lower predator-prey interactions. Ecological restoration intends to return the linear feature to a more natural state by tree planting; this is a long-term approach given the many years required before the planted trees mature. This could reduce the preferred forage for prey species such as moose, which in turn may reduce wolf populations and increase caribou survival (Spangenberg et. al 2019). The functional restoration techniques are intended to help reduce predator-prey interactions in the short-term, allowing the ecological restoration techniques can take effect over a longer time frame.

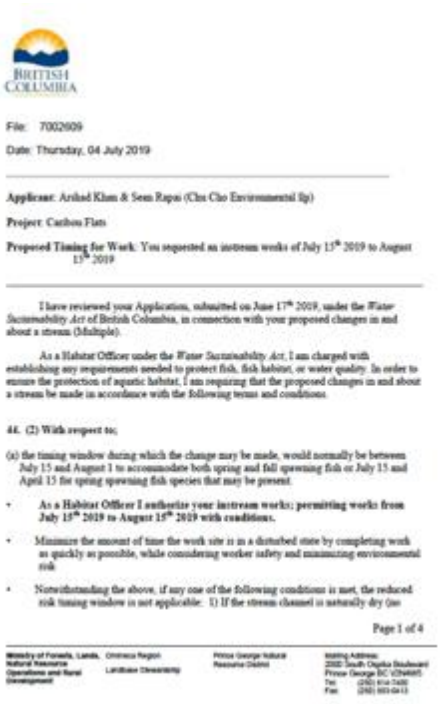
Mechanical site prep was completed using a Caterpillar 336D with a ripper tooth attachment, in preparation for tree planting, and roadside slash was pulled onto the road surface where possible. Tree planting was carried out in August 2020 with white spruce and scrub birch, within the treatment units that received the mechanical site preparation treatments. Community engagement regarding the project was conducted during Science Week in Tsay Keh Dene, in Setember 2019, and in November 2020 through the Tsay Keh Dene Nation Tracker newsletter.

Chu Cho Environmental and Tsay Keh Dene Nation intend to continue the Chase Caribou Road Restoration Program into the future. This program has now included the restoration of both the Caribou Flats Road, and the adjacent Lay Creek Road. More information on both the road restoration program, and the caribou stewardship programs that both Tsay Keh Dene Nation and Chu Cho Environmental are leading can be found on the Chu Cho Environmental YouTube channel. The project team is committed to protecting and reclaiming habitat to benefit the imperiled Chase caribou.

4 Appendix

4.1 Appendix 1 – Permits

4.1.1 Working in and about a stream (Sec 11 Water Sustainability Act)



BRITISH COLUMBIA

File: 7002609

Date: Thursday, 04 July 2019

Applicant: Arshad Khan & Sean Rapai (Chu Cho Environmental llp)

Project: Caribou Flats

Proposed Timing for Work: You requested an instream works of July 15th 2019 to August 15th 2019

I have reviewed your Application, submitted on June 17th 2019, under the *Water Sustainability Act* of British Columbia, in connection with your proposed changes in and about a stream (Multiple).

As a Habitat Officer under the *Water Sustainability Act*, I am charged with establishing any requirements needed to protect fish, fish habitat, or water quality. In order to ensure the protection of aquatic habitat, I am requiring that the proposed changes in and about a stream be made in accordance with the following terms and conditions.

44. (2) With respect to;

(a) the timing window during which the change may be made, would normally be between July 15 and August 1 to accommodate both spring and fall spawning fish or July 15 and April 15 for spring spawning fish species that may be present.

- **As a Habitat Officer I authorize your instream works; permitting works from July 15th 2019 to August 15th 2019 with conditions.**
- Minimize the amount of time the work site is in a disturbed state by completing work as quickly as possible, while considering worker safety and maximizing environmental risk.
- Notwithstanding the above, if any one of the following conditions is met, the reduced risk timing window is not applicable: 1) If the stream channel is naturally dry (no

Page 1 of 4

Ministry of Forests, Lands, Natural Resource Operations and Rural Development — Omineca Region — Land Use Stewardship — Prince George Natural Resource District — Mailing Address: 2000 South Ospika Boulevard Prince George BC V2N4W5 Tel: (250) 614-7400 Fax: (250) 565-6413

- Do not work in weather conditions likely to contribute to sediment production to the stream.

(e) the salvage or protection of fish or wildlife while the change is being made or after the change has been made,

- If dewatering of the worksite is necessary, fish salvage must occur on a fish-bearing stream prior to commencing works. A fish salvage permit must be obtained http://www.env.gov.bc.ca/psdr/
- Measures must be taken to ensure that equipment (e.g. water pumps) does not harm aquatic life.
- Do not disturb wildlife and/or their residences (e.g. beaver lodges) within the project area.

(f) the protection of natural materials and vegetation that contribute to habitat or stream channel stability,

- Minimize disturbance to natural materials (e.g. embedded logs) and vegetation that contribute to habitat or stream channel stability.
- Establish natural vegetation as part of the erosion control, including willow staking, and other plantings in the riparian area.

(g) the restoration of the worksite after the change has been made,

- Grade disturbed areas to a stable angle after work is completed and revegetate these areas to prevent surface erosion.
- Protect disturbed soil areas on the banks and areas adjacent to the stream from surface erosion.
- Restore all in-channel or active floodplain habitats that have been disturbed to a condition that is enhanced from their original state.
- Remove any remaining sediment and erosion control measures.
- Complete post-construction multi-year monitoring to ensure your revegetation meets full survival.

Page 3 of 4

flow) or frozen to the bottom at the worksite and the instream activity will not adversely impact fish habitat (e.g. result in the introduction of sediment into fish habitat). 2) If construction of a winter crossing is proposed and such works does not adversely impact the stream channel (including stream banks), fish habitat or fish passage.

(b) the minimum instream flow or the minimum flow of water that must remain in the stream while the change is being made,

- The natural rate of water flow must be maintained upstream and downstream of the worksite during all phases of instream activity.

(c) the removal of material from the stream or stream channel in connection with the change,

- The removal of material must not lead to stream channel instability or increase the risk of sedimentation into the watercourse.
- Any spoil materials must be placed in a location which ensures that sediment or debris does not enter the watercourse.

(d) the addition of substance, sediment, debris or material to the stream or stream channel in connection with the change,

- Instream activities must be conducted in the dry and the worksite must be isolated from water flowing in the stream channel.
- Riprap must be clean and free of sediment producing material.
- All equipment must be located and operated in the dry.
- Equipment used in close proximity to the wetted perimeter must be free of deleterious material (e.g. hydrocarbons) and in good mechanical condition (e.g. no fuel or hydraulic leaks).
- Measures must be taken to ensure that no harmful material (e.g. fuel and other hydrocarbons, soil, road fill, or sediment), which could adversely impact water quality, fish and other aquatic life, and/or fish habitat, can enter the wetted perimeter as a result of the project activities.
- Erosion and sediment control structures are to be available onsite and utilized as necessary.

(k) the requirement to obtain an approval from the federal Department of Fisheries and Oceans in connection with the change.

- Proponents are responsible for complying with the federal *Fisheries Act*. No serious harm to fish is authorized by this document, where serious harm is the death of fish or any permanent alteration to, or destruction of, fish habitat.
- Fisheries and Oceans Canada (DFO) Habitat technologists may authorize a net loss of fish habitat, where a mitigation/compensation package can be negotiated between DFO and the proponent.
- Proponents are responsible for determining whether the federal Department of Fisheries and Oceans (DFO) must be consulted with and whether an authorization from DFO is required prior to making the change.

This document does not supersede the requirements of the *Water Sustainability Act* and Regulations, Federal *Fisheries Act* or any other related legislation. The proponent is obligated to comply with all applicable federal, provincial or municipal enactments. For more information on the *Water Sustainability Act*, Section 11 Change Approval and Authorization for "Changes In and About a Stream" can be found at: http://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-licensing-rights/working-around-water

Retain a copy of this document on site during the works.

If you have any questions or concerns, I can be reached at 250-614-7484.

Regards,

Duncan M'Coll M.Sc. R.P.Bio.
Sr. Ecosystems Biologist - Omineca Region
Ministry of Forests, Lands, Natural Resource Operations and Rural Development
Prince George, BC
250-614-7484
duncan.mccoll@gov.bc.ca

4.1.2 FRPA sec 52(1)(b) permit to damage Crown timber

BRITISH COLUMBIA

File: 10550-20/Section 52

July 3, 2019

Sean Rapai
Chu Cho Environmental
1940 Third Avenue
Prince George, British Columbia
V2M 1G7

Dear Sean Rapai:

Under the authority of Section 52(1)(b) of the *Forest and Range Practices Act*, the Ministry of Forests, Lands, Natural Resource Operations and Rural Development approves your request to cut, damage and/or destroy Crown timber for Caribou habitat restoration purposes on the non-status Caribou Flats road to the extent described below.

This authorization is only for those areas that are shown in red on the attached map.

The timber that may be cut is limited to the following:

- Timber has to be located on the Caribou Flats road and no damage must occur on the timber adjacent to the road.

Timber that is cut must be disposed of in the following manner:

- All merchantable spruce that is cut must be piled and burned or cut into chunks that are less than 1 m in length for spruce beetle management purposes.
- All remaining cut timber must be lopped and scattered to abate fire hazard unless approved by a Ministry of Forests, Lands, Natural Resource Operations and Rural Development official.
- Mechanical site preparation and other soils work has to be conducted in such a manner to prevent siltation intake into the streams.
- Tree seedlots to be planted as a part of the habitat restoration project have to comply with the Climate-Based Seed Transfer guidelines.
- All work on this project has to follow the Caribou Best Management Practice principles to avoid the site and landscape level impacts and adhere to the activity timing constraints to minimize the disturbance and stress to animals occupying the area.

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Ministry of Forests, Lands, Natural Resource Operations and Rural Development — Mackenzie Forest District | Location: [illegible] | Mailing Address: [illegible] | Tel: [illegible] | Fax: [illegible]

Sean Rapai
Chu Cho Environmental

Timber must not be removed from the site unless the removal is authorized under an agreement under the *Forest Act* or a written exemption from Section 52(3) of the *Forest and Range Practices Act* is provided by the District Manager.

Any burning that is to be conducted will be done so in accordance with applicable legislation and municipal bylaws.

Any Crown timber cut under this authorization must not be offered for sale or removed from the site.

This letter of authorization is in effect from July 3, 2019 to October 31, 2019 or until you receive notification in writing that the authorization has been terminated.

Yours truly,

Ryan Bichon
District Manager
Mackenzie Forest District
Ministry of Forests, Lands, Natural Resource Operations and Rural Development

Attachment - Map

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4.2 Appendix 2 - Road prescription data collection form

Road Rehab Prescription Card

Site ID:
Site location:
Date:
Crew:
Time:
Station #:
Chainage:
Proposed prescription:
Road width:
Action:
Elevation (m):
Difficulty:
Aspect:
Additional notes:
Culvert present?:
Riparian feature present?:
Culvert state?:
Type of riparian feature:
Slope (degrees):
Slope Continuity:
SSL:
Slope Position:
SSR:
Slope Length:
Surface Shape:
Gullies/100m:
Pine Snags:
Pine Snag Avg. dbh:
Snags Other:
Other dbh:
Plot Size:
BGC Zone:
Subzone:
Variant
Phase:
Site Series:
CWD:
Moisture:
Nutrient:
Comments:

4.3 Appendix 3

4.3.1 Equipment used to complete vegetation monitoring

- Measuring stick
- Pigtail aluminum stakes
- Aluminum tags
- Flagging tape
- Pencil
- Compass
- GPS unit
- Camera
- Datasheets/iPad
- Soil auger
- Vegetation ID book/reference cards
- Laser range finder

4.3.2 Equipment used to complete wildlife camera-trap component

- 15 infrared motion-sensing cameras, with housing, padlock, straps, SD cards, and batteries
- Drill, driver bit hex washer head screws
- Measuring stick or tape
- Ladder
- Handsaw to remove branches, during camera placement and in detection zone
- Compass
- GPS unit
- Camera
- Pencil
- iPad with data sheets

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