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Appendix 19A Cumulative Effects Assessment



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Annex A: Project Inclusion List for Cumulative Effects Assessment

Annex B: Spatial Boundaries for Projects and Activities included in the Cumulative Effects

Assessment

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ACRONYMS

Abbreviations and Units of Measure	Definition
Agency (the)	Canadian Environmental Assessment Agency
AIR	Application Information Requirements
Application (the)	Application for an Environmental Assessment Certificate
ARD/ML	Acid Rock Drainage/Metal Leaching
BC	British Columbia
BC <i>EAA</i>	British Columbia Environmental Assessment Act
BC EAO	British Columbia Environmental Assessment Office
BC MFLNRO	British Columbia Ministry of Forests, Lands and Natural Resource Operations
BC MOE	British Columbia Ministry of Environment
BGC	biogeoclimatic zone
BMP	Best Management Practice
С	construction
CEA	Cumulative Effects Assessment
CEAA, 2012	Canadian Environmental Assessment Act, 2012
CL	closure
CLRUTP	Current Land and Resource Use for Traditional Purposes
dBA	decibel A scale
D/C	decommissioning and closure
EA	Environment Assessment
EIS Guidelines	Environmental Impact Statement Guidelines
EMP	Environmental Management Plan
FSR	Forest Service Road
GBPU	grizzly bear population unit
GIS	Geographic Information System
ha	hectare
ISMP	Invasive Species Management Plan
km	kilometre
km²	square kilometre
LDN	Lhoosk'uz Dene Nation
LSA	Local Study Area
LSVMRP	Landscape, Soils and Vegetation Management and Restoration Plan
m	metre



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Abbreviations and Units of Measure	Definition
MPB	Mountain Pine Beetle
MWMP	Mine Waste Management Plan
MWAMP	Mine Water Management Plan
NTLU	Non-Traditional Land Use
NTLRU	Non-Traditional Land and Resource Use
NEEF	Nechako Environmental Enhancement Fund
0	operations
OPS	Operational Policy Statement
%	percent
PC	post-closure
PEM	Predictive Ecosystem Mapping
PIL	Project Inclusion List
Project (the)	Proposed Blackwater Gold Project
RCP	Reclamation and Closure Plan
RDEA	Regional District Electoral Area
RSA	Regional Study Area
SARA	Species at Risk Act
SC	Statistics Canada
SECP	Sediment and Erosion Control Plan
TAMP	Transportation and Access Management Plan
TEM	Terrestrial Ecosystem Mapping
TK/TLU	Traditional Knowledge / Traditional Land Use
TLUS	Traditional Land Use Study
TSF	Tailings Storage Facility
TSS	Total Suspended Solids
t/d	tonnes per day
VC	Valued Component
VRAMP	Visual Resources and Aesthetics Management Plan
WLMP	Wildlife Management Plan
WQLDMP	Water Quality and Liquid Discharges Management Plan

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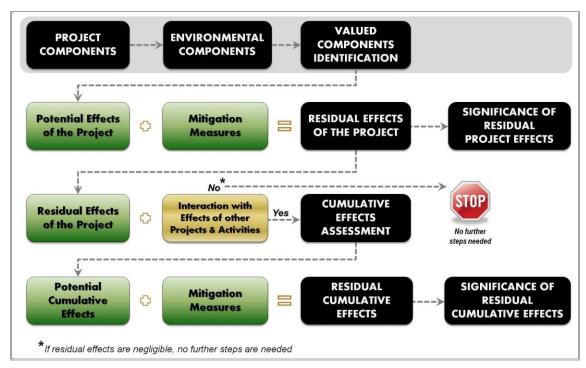
19.1 Background

This appendix presents the cumulative effects assessment (CEA) completed for the Project. It consolidates the information presented in the Environmental Assessment (EA) (Section 5 through Section 9 of the Application) into a single stand-alone document. It also provides an overview of the methodology used to assess project effects.

The potential for cumulative effects arises when the residual effects of a project affect (i.e., overlap and interact with) the same resource/receptor that is affected by the residual effects of other historical, existing, or reasonably foreseeable future projects or activities. The CEA for the Blackwater Project (the Project) considers the potential environmental, economic, health, social, and heritage cumulative effects of the Project as required by the federal Environmental Impact Statement Guidelines (Agency 2013a) and the provincial Application Information Requirements (BC EAO 2013a).

19.2 General Approach to Project Effects Assessment

The general approach used to determine potential residual effects, mitigation measures, anticipated residual effects, and their significance is illustrated in **Figure 19.2.1-1**.



Note: Modified from BC EAO (2013a)

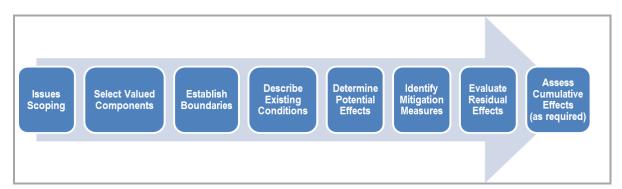
Figure 19.2.1-1: Effects Assessment General Approach Flow Chart



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This approach is consistent with the Guideline for Selection of Valued Components and Assessment of Potential Effects (BC EAO, 2013b). **Figure 19.2.1-2** presents a simplified version of the steps in the assessment process.



Source: BC EAO, 2013b

Figure 19.2.1-2: Effects Assessment Process Flow Chart

Section 4 of the Application describes the methodology used to assess the potential residual and cumulative effects of the interaction of Project activities with respect to the five pillars—environmental, economic, social, heritage, and health components. Baseline characterization and the results of consultation and engagement activities informed the identification of the Valued Components (VCs) representative of the five pillars. VCs are defined as any part of the environment (natural or human) that is considered important by the Proponent, Aboriginal groups, public, scientists, and governments involved in the assessment process. Importance may be determined on the basis of values as identified by Aboriginal groups' interests, scientific literature, and regulatory standards or requirements, biodiversity, and sensitivity to project effects. Indicators are metrics used to measure and report on the condition and trend of a VC and are intended to further focus and facilitate the analysis of interactions between the project and the selected VC (BC EAO, 2013b).

The baseline characterization provided information on the important features of each of the five pillars and associated processes, their interrelationships and interactions, as well as the variability within and among resources, processes, and interactions over the temporal scale as identified in the Application. This information is presented in sufficient detail to allow characterization of each component before any disturbance to the environment due to the Project. In describing the environmental components, both scientific and available traditional knowledge has been included, as well as the indicators and measures of component health and integrity used for the analysis. The baseline characterization addresses the resilience of the subject area, and relevant historical information. Where little or no information exists, specific studies have been designed to gather further information. The background characterization covers all relevant seasonal and temporal variations. Detailed information is provided in the appendices of this Application and is summarized in the Application. The summary will be focused on representative factors and/or indicators of all of the five pillar components and selected VCs that may be affected by the Project.



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Baseline characterization and the results of consultation and engagement activities provided the information to allow for the identification of the VC representative of the five pillars. Once the identification of VCs was completed (Sections 5.2.1; 5.3.1; 5.4.1; 6.2.1; 7.2.1; 8.2.1; and 9.2.1 of the Application), the methodology continued with the identification of potential effects and mitigation measures. Mitigation measures were proposed for each VC as required, taking into consideration the magnitude and duration of the potential effects of the Project. The mitigation measures are discussed in relation to their expected effectiveness and the risk associated. Following this approach, residual effects were determined subsequent to the application of mitigation measures. The residual effects are the basis for the determination of significance.

Following the assessment of the residual effects of the Project, a cumulative effects assessment was conducted for each VC for which there is a residual effect, taking into consideration the past, present, certain (the physical activity will proceed or there is a high likelihood that the physical activity will proceed, e.g., the Proponent has received the necessary authorizations or is in the process of obtaining those authorizations) and reasonably foreseeable (the physical activity is expected to proceed, e.g., the Proponent has publicly disclosed its intention to seek the necessary EA or other authorizations to proceed) (Agency, 2013a) future projects and activities. The rationale for the selection of projects and activities (both included and excluded) is presented in the Application. Uncertainties and assumptions used in the significance assessment of residual effects and cumulative effects are presented under each VC in the Application.

The same methodology is applied to the determination of Project effects and cumulative effects. The assessment methodology is described in **Section 4**, and specifically discusses:

- The scope of the EA:
- A list of the agencies, Aboriginal groups, and stakeholders that reviewed and commented on the draft AIR (Appendix 4A of the Application). Comments provided on the draft AIR are presented in Appendix 3.1.3.A of the Application;
- Description of applicable standards used for baseline characterization, effects assessment, and determination of significance (Table 19.3.3-1);
- A list of applicable guidance documents and provincially/regionally developed Best Management Practices (BMPs) that will be implemented;
- A list of all VCs considered in the EA; including the rationale and justification for Candidate VCs, and Selected VCs;
- Methods used for assessing the potential and residual effects of the Project and cumulative effects (considering past, present, certain, and reasonably foreseeable future projects). The assessment included the construction, operations, closure, and postclosure phases of the Project;
- How the residual effects of the Project were described for each VC, considering the following factors:
 - o Context;



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- Magnitude;
- Geographic extent;
- Duration;
- o Reversibility; and
- Frequency.
- The criteria and rationale for each of the above listed factors as it applies to each VC;
- How likelihood will be applied to describe the certainty of occurrence of the residual effect for each VC;
- How the significance of the residual effects was determined for each VC; and
- How confidence was applied to characterize the level of uncertainty associated with both the significance and likelihood determinations.

Guidance documents and Best Management Practices (BMPs) (Section 4, Table 4.1-1 Provincial and Federal Guidance Documents and BMPs) from the BC EAO, the Agency and other members of the Working Group were used in the development of the assessment methodology for the Application, including:

- Considering Aboriginal Traditional Knowledge in Environmental Assessments conducted under the Canadian Environmental Assessment Act – Interim Principles (Agency, 2013d);
- Cumulative Effects Assessment Practitioners' Guide (Cumulative Effects Assessment Working Group, 1999);
- Guideline for Selection of Valued Components and Assessment of Potential Effects (BC EAO, 2013b);
- Operational Policy Statement for Addressing "Purpose of" and "Alternative Means" under the Canadian Environmental Assessment Act, 2012 (Agency, 2013c);
- Operational Policy Statement for Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012 (Agency, 2013b);
- Useful Information for Environmental Assessments (Health Canada, 2010); and
- Agency's Reference Guide Determining Whether a Project is Likely to Cause Significant Adverse Environmental Effects.

19.2.1 Assessment Boundaries

Assessment boundaries define the scope or limits of the assessment. They encompass the areas and time periods during which the Project is expected to interact with the VCs (spatial and temporal boundaries), any constraints placed on the assessment of those interactions due to political, social, and/or economic realities (administrative boundaries), and any limitations in predicting or



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measuring changes (technical boundaries). Each of these boundaries is described in further detail in the subsections below.

19.2.1.1 Spatial Boundaries

The Project site, Local Study Area (LSA), and Regional Study Area (RSA) boundaries were selected to cover the geographic areas in which the Project is expected to interact with each VC and in which the potential environmental, economic, social, heritage, and health effects of the Project are expected to be measurable. The following criteria were considered during the identification of spatial boundaries:

- Physical extent (terrestrial, freshwater aquatic, and airshed) of the Project site, including mine site and offsite Project components, as described in **Section 2.2** of the Application;
- Extent of biophysical resources potentially affected by the Project:
- Extent of social, economic, heritage, and health effects, including those of First Nations and Métis groups, potentially occurring from the Project; and
- Results of consultations with Aboriginal groups, the public, and government agencies on the scoping of issues to be addressed in the Application.

The Project site refers to the land where proposed facilities or infrastructure will be developed (i.e., the footprint) and the land located in between these facilities or in very close proximity¹. The Project site includes the mine site, the mine access road, the airstrip, the transmission line, the freshwater supply system, and the Kluskus Forest Service Road (FSR) between Engen and the mine access road.

The LSA is defined as an area within which all (or most) potential Project effects are expected to occur (BC EAO, 2013b). The LSA for the Project was defined as the Project site and surrounding area, which varies with each VC, where there is a reasonable potential for effects to occur to a VC due to an interaction with the Project components or activities identified in **Table 19.2.1-1**. The RSA is defined as a larger area (relative to the LSA) and used to provide context for the assessment of potential Project effects (BC EAO, 2013b).

The RSA for the Project was defined as the area within which cumulative effects would be assessed, therefore an area where potential interactions with other projects or activities is possible. RSA selection rationale will be specific to each VC and may vary between VCs.

19.2.1.2 Temporal Boundaries

The temporal boundaries for the assessment are aligned with the construction, operations, closure, and post-closure phases of the Project. These temporal boundaries are applied to all VCs.

¹ Buffers were applied around proposed on-site and off-site infrastructure to determine the Project site. Areas located in between project infrastructure or immediately adjacent are considered to be part of the Project site although no development is proposed in those areas.



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Table 19.2.1-1: Description of Spatial Boundaries used for each Valued Component

Valued Components		Study Area	Description		
1.	Noise and Vibration	Local Study Area (LSA)	Mine Site: Approximately circular area within a 1.5 km distance from the proposed mine site permanent noise sources which refers to permissible sound level of 40 decibel, a scale (dBA) likely to be adopted for this open pit mining project. The exact shape of the LSA will depend on results of noise modelling and it will be presented as noise contours.		
			Transmission Line, Mine Access Road, Airstrip, Freshwater Supply Pipeline, and Kluskus FSR: overlapping the linear component footprint by 1.5 km on each side (3 km wide).		
		Regional Study Area	Mine Site: Overlaps the proposed mine footprint by 4 km in each direction. The RSA is centered on and extends over a circular area with a radius of 5 km for area of the proposed mine site open pit mine, processing facilities, and waste disposal sites.		
		(RSA)	Transmission line, mine access road, airstrip, freshwater supply pipeline and Kluskus FSR: overlapping the linear component footprint by 2.5 km on each side (5 km wide).		
2.	Air Quality	LSA	Mine Site: 10 x 10 km² centred on the proposed open pit.		
3.	Climate Change		Transmission line, mine access road, airstrip, freshwater supply pipeline and Kluskus FSR: 3-km wide corridor (e.g., 1.5 km on each side) along the linear components.		
		RSA	Mine Site: 50 x 50 km around the proposed open pit.		
			Transmission line, mine access road, airstrip, freshwater supply pipeline and Kluskus FSR: same as LSA.		
4. 5. 6.	Surface Water Flow Surface Water Quality Sediment Quality Wetlands Fish Habitat Fish	LSA	 Mine Site: Entire watersheds of Davidson Creek, Creek 661, Turtle Creek, and Creek 705. Tributaries flowing in to the south side of Tatelkuz Lake. Chedakuz Creek from confluence with Creek 661 to Tatelkuz Lake. Chedakuz Creek from Tatelkuz Lake to confluence with Turtle Creek. 		
7. 8.			Transmission line, mine access road, airstrip, freshwater supply pipeline, and Kluskus FSR: 100 m on either side of the centre line of these proposed developments (i.e., 200 m total width).		
9.			Note: wetland spatial boundaries will follow the boundaries associated with ecosystem composition and plant species and ecosystems at risk for the assessment of the transmission line, mine access road airstrip, freshwater supply pipeline and Kluskus FSR.		
		RSA	Mine Site: Entire watershed of Chedakuz Creek not included in LSA. Entire watershed of Laidman Lake not included in the LSA.		
			Transmission line, mine access road, airstrip, freshwater supply pipeline, and Kluskus FSR: Same corridor as LSA.		
			Note: wetland spatial boundaries will follow the boundaries associated with ecosystem composition and plant Species and ecosystems at risk for the assessment of the transmission line, mine access road, airstrip, freshwater supply pipeline and Kluskus FSR.		



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Valued Components	Study Area	Description
10. Groundwater Quantity11. Groundwater Quality	LSA	 Mine Site: 1 km around the proposed mine footprint. Transmission line, mine access road, airstrip, freshwater supply pipeline and Kluskus FSR: Not required.
	RSA	Mine Site: incorporates the Davidson Creek watershed, Tatelkuz Lake, Creek 661 watershed, Turtle Creek watershed, and portions of the upper Fawnie Creek watershed.
		Transmission line, mine access road, airstrip, freshwater supply pipeline, and Kluskus FSR: Not required.
12. Physiography and	LSA	Mine Site: 500 m from the proposed Project mine site boundary.
Topography 13. Surficial Geology and Soil Cover		Transmission line, mine access road, airstrip, freshwater supply pipeline, and Kluskus FSR: 100 m beyond the proposed linear component boundary.
14. Soil Quality	RSA	Mine Site: 3,000 m from the proposed Project mine site boundary.
15. EcosystemComposition16. Plant Species and		Transmission line, mine access road, airstrip, freshwater supply pipeline and Kluskus FSR: 500 m beyond their proposed linear component boundary.
Ecosystems at Risk		
17. Amphibians	LSA	Mine Site: Approximate 500 m buffer around the proposed mine site facilities.
18. Waterbirds19. Forest and Grassland Birds		Transmission line, mine access road, airstrip, freshwater supply pipeline, and Kluskus FSR: approximately 250 m buffer from each side of the linear component boundary.
20. Moose21. Caribou22. Grizzly Bear23. Furbearers24. Bats	RSA	Mine Site: Includes ungulate winter range established for the Tweedsmuir-Entiako caribou herd (U-7-012). The western and southern edges of the RSA outline these winter ranges. The southwestern boundary follows the Upper Blackwater Management Zone where the RSA then follows the Blue Road till it reaches the Ootsa – Kluskus FSR and follows this north until it reaches the Nechako Reservoir. The northern boundary of the RSA follows the shoreline of the Nechako Reservoir. The northern boundary of the RSA follows the shoreline of the Nechako Reservoir.
25. Invertebrates		Transmission Line and Kluskus FSR. Approximate 1 km buffer from the linear component boundary;
		Grizzly bear RSA will also consider effects in the context of the Provincial Grizzly Bear Population Management Units.
		Caribou regional effects will also be considered in the context of the Ungulate winter range and herd area.

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Valued Components Study Area		Study Area	Description		
26. 27.	Regional and Local Employment and Businesses	LSA	• Statistical reporting units use by Statistics Canada (SC) and the Government of BC: Vanderhoof, Fraser Lake, Bulkley-Nechako Regional District Electoral Area (RDEA) D, Bulkley-Nechako RDEA F, and eleven populated Indian Reserves: Stony Creek 1, Laketown 3, Nautley (Fort Fraser) 1, Seaspunkut 4, Stellaquo 1, Kluskus 1, Tatelkus Lake 28, Sundayman's Meadow 3, Euchinico Creek 17, Trout Lake Alec 16 and Nazco 20.		
28.29.30.31.32.	Government Finance Demographics Regional and Community Infrastructure Regional and Local Services	RSA	• Statistical reporting units use by SC and the Government of BC: Fraser-Fort George RDEA C, Bulkley-Nechako RDEA C and Bulkley-Nechako RDEA B, Prince George, Burns Lake, Fort St. James, and 12 Indian Reserves: Nak'azdli (Necoslie) 1, Sowchea 3, William Prairie Meadow 1A, North Tacla Lake 7, Dzitline Lee 9, Tache 1, Binchie 2 (Pinchie 2), Ye Koo Che 3; Burns Lake 18; Woyenne 27; Duncan Lake 2; and Palling 1.		
33.		LSA	500-m buffer beyond the proposed Project footprint.		
	and Resource Use	RSA	Based on Vanderhoof Land and Resources Management Plan. Includes all subzones that overlap with LSA or fall within RSAs identified for other disciplines (i.e., aquatics). To provide representative information the eastern RSA boundary was moved towards the west in order to balance out the area on either side of the proposed transmission and Kluskus FSR.		
34.	Current Land and Resource Use for Traditional Purposes	source Use for	 Mine site: Same as Aquatic LSA, with some additions to include the west facing slopes of the Nechako Range up to the skyline between Tatelkuz and Kuyakuz mountains. Transmission Line and Kluskus FSR: same as Wildlife LSA. 		
		RSA	 Mine site: same as Wildlife RSA with some additions from the aquatics RSA in the south portion to include the entire watershed of Laidman Lake and Chedakuz Creek. Transmission Line and Kluskus FSR: same as Wildlife RSA. 		
35.	Visual Resources	LSA	A viewshed analyses will be generated using Geographic Information System (GIS) modelling software and a Digital Elevation Model (DEM) to delineate the LSA, where line of sight with project facilities may affect existing land uses and scenic quality.		
		RSA	An extended viewshed analyses will be generated to delineate the RSA from where specific viewpoints or recreation sites may be affected at a greater distance.		



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Valued Components Study Area		Description	
36. Archaeological S37. Historic Heritage Sites38. Paleontological	tes LSA	 Mine Site: 15-km buffer around the proposed mine site footprint. Transmission line, mine access road, airstrip, freshwater supply pipeline, and Kluskus FSR: 500 m from centerline in either direction (1 km total). 	
Resources	RSA	 Mine Site: 33 km by 25 km rectangle around mine site; Transmission line, mine access road, airstrip, freshwater supply pipeline, and Kluskus FSR: 10-km buffer from centerline in either direction (20 km total). 	
39. Environmental Exposures40. Workers Health a Safety	nd RSA	 Same as LSA defined for social and economic VCs. Note: the LSA for environmental exposures may be revised if biophysical effects are demonstrated outside of proposed spatial boundaries. Same as RSA defined for social and economic VCs. 	

Note: ¹ The proposed Project footprint refers to the land where proposed Project facilities or infrastructure will be developed. The proposed Project footprint includes the Rights-of-Way for the transmission line, mine access road, airstrip, and the freshwater supply pipeline. The proposed Project footprint does not include existing infrastructure such as the forest service roads or other roads that are currently being used by third parties.



² The proposed linear component boundary, also referred to as the corridor width, for each project feature is based upon the feature ROW width, with an additional 50 m buffer on each side. ROW and linear component boundary widths are as follows: transmission line and re-routes - ROW is 40 m width, and linear component boundary is 140 m width, fresh water pipeline and airstrip access road – ROW is 10 m and linear component boundary is 110 m, airstrip - ROW is 100 m and linear component boundary is 200 m, mine site access road – ROW is 20 m and linear component boundary is 120 m.

³ The terrestrial study areas have been defined in relation to the proposed Project boundaries. When proposed Project components are in close proximity, there is a possibility that study areas would overlap, and if this is the case, the study areas will be merged to avoid duplication.

⁴ If the results of the assessments indicate the spatial boundaries need to be adjusted to ensure the full extents of the effects are captured, the boundary will be adjusted for the Application, with supporting justification/rationale.

⁵ BC = British Columbia; dBA = decibel A-scale; FSR = Forest Service Road; GIS = Geographic Information System; km = kilometre; km² = square kilometre; LSA = Local Study Area; m = metre; NTLRU = Non-Traditional Land and Resource Use; RDEA = Regional District Electoral Area; RSA = Regional Study Area; SC = Statistics Canada; n/a Not Applicable.

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The temporal boundaries for the Project assessment are as follows:

- The construction phase is scheduled to occur over two years (i.e., years -2 and -1), starting immediately following receipt of the required permits;
- The operations phase is scheduled to extend for approximately 17 years (i.e., years +1 to +17), starting once the plant site is constructed, commissioned, and ready for ore processing;
- The closure phase is estimated to occur during the 18 years (i.e., years +18 to +35) following the cessation of mining and ore processing activities, when the mine site buildings and infrastructure will no longer be needed. Activities will include decommissioning of plant facilities and infrastructure and their abandonment and removal from the mine site, the implementation of the site reclamation plan and the open pit flooding to the point where the mine site starts discharging water back to the environment; and
- The post-closure phase is estimated to start immediately after completion of the closure activities (i.e., following year +35). Post-closure maintenance and monitoring will be conducted for a minimum of 12 years.

The temporal boundaries proposed above are consistent with the Project Description presented in **Section 2.2** of the Application. The Proponent has not made a final decision to construct the Project and this will also depend on obtaining provincial and federal approvals, therefore foreseeable modifications to the proposed Project involve only the construction schedule. The assessment presented remains valid as it is independent of when construction phase starts because seasonal factors affecting construction activities have been taken into account. Also, given the nature of mining developments, there is a possibility that the mine plan be adjusted in the future should additional resources and/or reserves be found. If this is the case, the Proponent will satisfy any applicable permitting requirements.

Seasonal factors affecting any of the VCs have been taken into account in the baseline characterization and the assessment of potential and residual effects of the Project. The environmental management plans (EMPs) presented in **Section 12.2** of the Application provide specific information on sensitive periods for wildlife and fish and describe the mitigation measures that apply to those periods.

Community and Aboriginal Traditional Knowledge is considered in the assessment of potential effects under each VC. If specific information pertaining to temporal boundaries is available, this is incorporated into the assessment of the VC.

19.2.1.3 Administrative Boundaries

Administrative boundaries refer to constraints imposed by data, political, economic, social, or related boundaries. Administrative boundaries may not apply to all VCs, and are most often used to define the LSA and RSA for economic and social VCs. These may include specific aspects of provincial and federal regulatory requirements, as well as regional planning initiatives that are



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relevant to the assessment of the Project's effects on a specific VC. The regulatory and policy context and the identification and nature of administrative boundaries and their effects on the assessment are described in the scope of assessment section for each VC (**Section 5**, Assessment of Potential Environmental Effects through **Section 9**, Assessment of Potential Health Effects) of the Application.

As appropriate, administrative boundaries were carried forward into the CEA.

19.2.1.4 Technical Boundaries

Technical boundaries refer to the constraints imposed on the EA as a result of limitations in data that can influence or limit the ability to predict potential effects of the Project. Technical boundaries may not apply to every selected VC or every assessment. Where they have been identified, technical boundaries are described for each affected VC in **Section 5**, Assessment of Potential Environmental Effects through **Section 9**, Assessment of Potential Health Effects of the Application.

As appropriate, technical boundaries were carried forward into the CEA.

19.3 Cumulative Effects Assessment Methodology

This section describes when an assessment of cumulative effects is required and identifies the projects and activities that were considered for this purpose. The CEA followed the Agency's Operational Policy Statement (OPS) on Assessing Cumulative Environmental Effects under *CEAA*, 2012 the OPS on Assessing Cumulative Environmental Effects under *CEAA*, 2012, Environmental Assessment Office User Guide (Government of BC 2010), and Guidelines for the Selection of Valued Components and Assessment of Potential Effects (BC EAO; 2013b).

19.3.1 Overview

A CEA must be considered if adverse residual effects are predicted to result from the construction, operation, or closure and post-closure of the Project².

A CEA for the Project assesses cumulative effects likely to result from adverse residual Project effects acting in combination with residual effects on the same VCs arising from projects or activities that have been or are likely to be carried out within the RSA. The rationale for the RSA is presented in **Table 19.2.1-1**. The CEA was conducted based on guidance on CEAs from the BC EAO (BC EAO, 2013b) and the Agency (Agency, 2013b). Cumulative effects assessment of most socioeconomic VCs are considered inherently cumulative in nature. The social VCs that have interactions with bi-physical components will consider cumulative effects separately.



² Assessment of cumulative effects is considered when the residual effect of the Project on the VC is determined to be other than non-significant (negligible).

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The CEA was completed for identified residual effects of the Project based on six steps listed below:

- All potential adverse residual Project effects that were identified and characterized in the Project effects assessment were carried forward into the CEA.
- Each predicted adverse residual Project effect on a VC was evaluated to determine if it
 might act cumulatively in space or time with the effects on the same VC caused by
 projects and activities described in the Project Inclusion List (PIL), and if that interaction
 was likely to occur. If the interaction was determined to be unlikely, the residual effect
 was not carried forward to the CEA, and the rationale for exclusion was documented. If,
 in the significance evaluation, the residual Project effect on a VC was determined to be
 'Not Significant negligible', that VC was not carried forward into the CEA, and the
 rationale for its exclusion was documented.
- Potential cumulative interactions or overlaps in space or time that were likely to occur
 were carried forward into the CEA, including residual effects from historical (closed)
 projects or activities, existing (currently active) projects and general land use activities,
 and reasonably foreseeable future projects.
- Potential adverse cumulative effects were assessed for each VC, and any necessary technically and economically feasible mitigation and enhancement measures were described to address the potential adverse effect. Effects that remained after application of additional mitigation were deemed to be residual cumulative effects and were characterized using the criteria set out in **Section 19.3.3.**
- The significance of residual adverse cumulative effects was assessed using the same criteria applied to determination of significance of residual Project effects (Section 4.3, Determination of Significance of Residual Effects of the Application) below and aggregated by VC.

The development of the cumulative effects methods is consistent with the Agency's Operational Policy Statement on Assessing Cumulative Environmental Effects under *CEAA*, *2012* (Agency, 2012). No committee has been established under section 73 or 74 of *CEAA*, *2012*; therefore, there are no relevant studies that can be used for CEA.

The potential for cumulative effects for accidents and malfunctions is presented in **Section 10** of the Application. The projects or activities in the Project Inclusion List (PIL) (**Annex A**) that could have residual effects were reviewed to fully understand the context of potential residual adverse effects interacting with potential effects arising from these four possible accidents or malfunctions associated with the Project. The spatial boundary for this assessment is the RSA.

19.3.2 Project Inclusion List

The methodology presented below was used to select and describe past, present, and/or future projects or activities that may interact with the VCs within the Project RSAs.



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The selection of which other projects and human activities to consider in the CEA was initially made by reviewing the following available information about projects and activities within the CEA RSAs:

- Historical (closed) projects or activities within the cumulative effects assessment RSAs;
- Existing (currently active) projects within the cumulative effects assessment RSAs;
- General land use activities within the cumulative effects assessment RSAs; and
- Reasonably foreseeable future projects (i.e., planned and approved projects) occurring within the cumulative effects assessment RSAs.

A PIL was developed for the CEA based on the British Columbia Major Projects Inventory (BC Ministry of Jobs, Tourism, and Skills Training, 2013) and other available information about past, present and future projects within the CEA RSAs. This PIL identifies those projects or human activities that may overlap spatially or temporally with the Project (**Table 19.3.2-1**). The detailed PIL and descriptions of various projects and activities used for assessing potential environmental, economic, social, heritage, and health effects are presented in **Annex A**.

Assessment of social and economic VCs was based on effects predicted over the RSA or beyond. The significance of potential Project effects was assessed by comparing the potential effects to baseline conditions and future trends that reflect the effects of approved and reasonably foreseeable projects expected to be developed within the near future. Because this approach examines Project effects in combination with the effects of other activity in the study region, this assessment is effectively cumulative in nature.

Two projects that were listed in the British Columbia Major Projects Inventory for Vanderhoof were not included in the CEA. These two projects do overlap spatially but not temporally and are not included in the PIL. Descriptions and rationale for exclusion of these projects is provided in **Table** 19.3.2-2.

Figures and area calculations were generated for the CEAs by investigating and rationalizing items on the PIL to represent past, present, and future activities within the local and regional study areas for the VCs. Where possible, the spatial footprint of a project was captured to enable area calculations. Activities taking place in a variable manner within a larger area were mapped on a separate figure. The maps to be considered for the CEA as well as the methodological approach to create these maps are provided in **Annex B**.



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Table 19.3.2-1: Summary Project Inclusion List

Project/Land Use	Description/Status	Spatial Overlap with Blackwater within Cumulative Effects RSA	Temporal Overlap with Blackwater
Nulki Hills Wind Project	Wind power project in Nulki Hills; up to 70 turbines; located 60 km north-northeast of mine site; 5 km east of Kluskus FSR pre-application stage with BC EAO	yes	yes
Fraser Lake Sawmill Biomass Project	12 MW power plant using sawmill waste to produce energy – start-up Q2-Q3 2014 permitting in process	yes	yes
Coastal GasLink Pipeline Project	The proposed Project involves the construction and operation of an approximately 650 km long natural gas pipeline 1219 mm (48-inch) in diameter from near Dawson Creek in northeast BC to the proposed LNG Canada LNG export facility near Kitimat.	yes	yes
Pacific Gas Looping Project	The proposed Project involves the construction of approximately 525 km of new 60 mm (24-inch) pipe, operating in parallel with the existing pipeline.	yes	yes
Mining – exploration	Two developed prospects, exploration programs, and numerous mineral claims and tenures; includes several New Gold mining exploration projects, such as Van Tine, Capoose, Fawnie, Emma, and Auro	yes	yes
Mining – existing	Endako Lake molybdenum mine; 65 km west of Vanderhoof	yes	yes
Forestry – logging	Various historical, active, and pending logging tenures and woodlot licences; private forest lands	yes	yes
Hunting, Trapping, Guide Outfitting	14 guide outfitter areas within the RSA, 78 traplines	yes	yes
Fishing and Hunting Lodges	23 commercial lodges within the RSA	yes	yes
Recreation	RSA supports year-round recreational activities	yes	yes
Agriculture	69 active range tenures within the RSA	yes	yes
Transportation	Traffic associated with recreation and other activities along the Kluskus FSR Several airports, airstrips, and aerodromes for fixed wing and seaplanes	yes	yes
Crown Land Tenures	25 provincial crown tenures are in place for various activities (agriculture, residential, etc.) in the access road and transmission line RSAs	yes	yes

Note: BC EAO = British Columbia Environment Assessment Office; FSR = Forest Service Road; km = kilometre; MW = megawatt; RSA = Regional Study Area; December 2013 was used as the cutoff date of included projects.



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Table 19.3.2-2: Projects Not Included in Cumulative Effects Assessment

Project/Land Use	Description	Status	Spatial Overlap with Blackwater within Cumulative Effects RSA	Temporal Overlap with Blackwater
Mining – Chu Molybdenum Mine Project	Open pit molybdenum mine, with an anticipated production of up to 90,000 t/d. Expected mine life is 20 years at this production rate. Withdrawn from BC EAO process due to weak financial markets and the depressed price of molybdenum. (http://a100.gov.bc.ca/appsdata/epic/html/deploy/epic_project_doc_index_347.html)	Historical – Withdrawn from BC EAO process on 13 July 2013 (http://a100.gov.bc.ca/appsdata/epic/html/deploy/epic_document_347 _35860.html) Project may be re-entered when market conditions improve.	Yes	No
Utility – Kenney Dam Cold Water Release Facility	Description from Major Projects Inventory (June 2013): Project to protect salmon on the Nechako River through either a cold water release facility (Kenney Dam) or other environmental enhancements, as part of an Aug 1997 agreement with the Government of BC, which resolves issues surrounding the Kemano dam. There are ongoing studies and consultation in progress, although construction is not expected to start for several years. The BC Provincial government is in negotiations with Alcan, First Nations, and local communities.	Available information and details provided by the RioTinto Alcan Nechaco Operations Coordinator (Mr. Justus Benckhuysen) indicate that this project is in the early stages of evaluation. Mr. Benckhuysen also indicated that RioTinto Alcan was not a proponent for this project.	Unknown - detailed project information unavailable	Unknown - detailed project information unavailable
	Update: Available information indicates that in 1997 Alcan–now Rio Tinto Alcan–agreed to put approximately \$50 million into a NEEF to help compensate for the environmental damage done to the watershed. In 2001, NEEF recommended that a cold water release facility be built in Kenney Dam, but that proposal didn't get provincial funding and wasn't followed up on. (Globe and Mail 2012; http://www.theglobeandmail.com/news/british-columbia/band-proposes-relief-facility-after-dam-floods-graveyards-bodies-wash-away/article4223724/)			
	Nechako Canyon Protected Area – Purpose Statement and Zoning Plan: Developed in March 2003 and incorporates known management issues associated with the existing operation and the proposed cold water release through Keeney Dam. No specific details regarding schedule were provided.			

Note: BC EAO = British Columbia Environment Assessment Office; RSA = Regional Study Area;

NEEF = Nechako Environmental Enhancement Fund; t/d = tonnes per day.



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19.3.3 Evaluation of Residual Adverse Cumulative Effects

Residual adverse cumulative effects that remained after the application of effective and feasible mitigation based on best practices and regulatory requirements were characterized for each VC using the same factors used to characterize residual Project effects. Residual cumulative effects on VCs were rated based on magnitude, geographic extent, duration, frequency, reversibility, context, likelihood and level of confidence (Table 19.3.3-1, Table 19.3.3-2, Table 19.3.3-3, Table 19.3.3-4, Table 19.3.5-1, Table 19.3.5-2).



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Table 19.3.3-1: Magnitude Rating Criteria for Characterizing Residual Effects

	Enviro	nmental: Ter	restrial			Environ	mental: Aquatics				Socia	I and Economic		Heritage	Atmosph	eric Environment	
Magnitude	Wildlife	Vegetation	Soils & Terrain	Fish and Fish Habitat	Wetlands	Surface Water and Sediment Quality ⁽¹⁾	Groundwater Quantity	Groundwater Quality ⁽²⁾	Surface Water Flow	Visual	Non- Traditional Land Use (NTLU)	Social & Economic	CLRUTP	Archaeology Palaeontology Heritage	Noise ⁽³⁾	Air Quality ⁽⁴⁾	Health
Negligible	not	not	Effects are not measurable	No detectable change from baseline	wetland extent or baseline (<1%	than the BC MOE Protection of Freshwater Aquatic Life 30- day average	Effects are not measurable (no change in water levels and flows from baseline conditions) Magnitude: effect considered on groundwater quantity only	Effects are not measurable (no change in elemental concentrations from baseline conditions) Magnitude: effect considered on groundwater quality only	Effects are not measurable (<5% change in flow from baseline conditions)	Change cannot be captured by the human eye	No detectable change from baseline	No detectable change from baseline	No detectable change from baseline	Little or no portion of the site is lost	Effects are not measurable	No effects	Effects may be indistinguishable in the population
Low	within the	1 to 10% reduction in area from baseline	1 to 5% change, depending on the parameter modified	Differs from mean baseline value, but is within range of natural variation, and below guideline or threshold	from baseline	months, maximum concentration	Some effects are noticeable, however recovery is relatively rapid and the effects result in either 5% to 10% change in contribution to surface water flow from baseline conditions or 1% to 10% reduction in wetland area from baseline	(CSR) standard	change in	Visible but distant or partially obscured	<1% change	Effect that occurs might or might not be detectable, but is within the normal range of variability	Project overlaps with very small portions of areas used for current traditional land and resource uses (<1% change) but wil not impede the activity.			Measured or estimated effect represents less than 1% change in the receptor (quality, quantity, or other attribute) from baseline conditions, and is within the range of normal variability	Effects can be distinguished in the population
Medium	less than high	reduction in	5% to 20% change, depending on the parameter	Differs from mean baseline value, approaches limits of natural variation, but is below or equal to guideline or threshold	10% to 20% reduction in area from baseline	Mean concentration above BCFWG 30-d guide 9 or more months, maximum concentration above BCFWG maximum guide up to 4 months	Effects occur and recovery is not relatively rapid and the effects result in either 10% to 20% change in contribution to surface water flow from baseline conditions or 10% to 20% reduction in wetland area from baseline	10% to 20% change in quality from baseline conditions with no change constituting a new CSR standard exceedance	10% to 20% change in flow from baseline conditions	Visible but distant	1% to 10% change	Effect is unlikely to pose a serious risk or benefit to the VC or to represent a management challenge	Project overlaps several areas used for curren		3 to 10 decibel increase over the background level	Measured or estimated effect represents a 1% to 10% change in the receptor (quality, quantity, or other attribute) from baseline conditions, and is unlikely to pose a serious risk to a receptor	Effects are clearly distinguishable and result in elevated awareness or concern among stakeholders or result in measurable change in the wellbeing of the population
High ⁽⁵⁾		area from	>5% to >20% change, depending on the parameter	Differs from mean baseline value, is outside range of natural variation, and beyond guideline or threshold	>20% reduction in area from baseline	BCFWG 30-d guide, maximum concentration always above	Change in groundwater levels and flows from baseline conditions are permanent and the effects result in either more than 20% change in contribution to surface water flow from baseline conditions or more than 20% reduction in wetland area from baseline	exceedance	>20% change in flow from baseline conditions			Effect is likely to pose a serious risk or benefit to the selected VC and, if negative, represents a management challenge	Project overlaps with large areas used for curren	t	More than 10 decibel increase over the background level	Changes in predicted ground-level concentrations are >10% above background and/or exceed a listed AAQO.	Effects are highly distinguishable and result in strong concern among stakeholders or result in substantive changes in the well-being of the population



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Note: Applicable Standards used are:

- (1) British Columbia Freshwater Guidelines (BCFWG)
- (2) Environmental Code of Practice for Metal Mines. Environment Canada, Mining and Processing Division, Mining Section, Document No. 1/MM/17, 2009
- (3) Some air quality impacts may occur beyond the boundaries of the air quality RSA. This is generally true of emissions that are not necessarily pollutants, but may contribute to atmospheric issues on a larger scale. "Global geographic extent" is used to describe impacts beyond the air quality RSA. Ambient Air Quality Objectives (AAQO)
- (4) Contaminated Sites Regulation (CSR) standard
- (5) High: A threshold of 20% change or loss is proposed for high magnitude. This is a general environmental practitioner approach, which has been used and supported in the past for resource development projects, including the Joint Review Panel Report on the Jackpine Mine Expansion Project which decision statement was made under *CEAA*, 2012.

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Geographic Extent Rating Criteria for Characterizing Residual Effects Table 19.3.3-2:

	Environme	ental: Terrest	rial			Environmer	ntal: Aquatics				Social and E	conomic	Heritage Atmospheric Environment				
Geographic Extent	Wildlife ⁽¹⁾	Vegetation	Soils & Terrain	Fish and Fish Habitat	Wetlands	Surface Water and Sediment Quality	Groundwater Quantity	Groundwater Quality	Surface Water Flow	Visual	Non-Traditional Land Use (NTLU)	Social & Economic ⁽²⁾	CLRUTP	Archaeology Palaeontology Heritage	Noise	Air Quality	Health
Site-Specific: Within the Project Site	the footprint but	of way	Effect is confined to project footprint right of way	Effects confined to the Project site	the Project	Effects are downstream of the Tailings Storage Facility	D	Effects confined to the Project site	Effects confined to the Project site	Not Applicable	Confined to the area directly disturbed by the Project	Not Applicable	Confined to the area directly disturbed/affected by the Project (footprint as well as areas now inaccessible due to Project)	The effect is confined to the Project site	Effect occurs within the property boundary	Measured or estimated effect occurs only within the boundaries of the Project site	Effect is limited to the on-site worker population
Local : Within the LSA	in the LSA -		Effect is confined to the LSA	Effects confined to the LSA: Local population; linear scale <100 km;		Effect is confined to the LSA	Effect is confined to the LSA	Effect is confined to the LSA	Effect is confined to the LSA	Size of the overlap between the viewshed of the proposed mine site facility or linear feature and the internal viewshed of a potential sensitive receptor within the area of the LSA	tenures and dispositions or the	Effect is confined to the LSA	Limited to the areas used currently for traditional land and resource uses that overlap with the LSA	Effects on a site or sites (restricted to areas of direct physical disturbance within the LSA)		Measured or estimated effect occurs only within the boundaries of the LSA. For socio-economic receptors, the effect will be limited to specific persons or communities	Effect occurs within the LSA population
Regional: Within the RSA	Effect is prevalent into the RSA – Regional (e.g., population effects to moose, deer, wolf)	Effect is confined to the RSA	Effect is confined to the RSA	Effects confined to the RSA: Multiple populations or species	the RSA	Effect is confined to the RSA	Effect is confined to the RSA	Effect is confined to the RSA	Effect is confined to the RSA	between the viewshed of the	Effect extends beyond the NTLU tenures and dispositions or the effect extend to NTLU tenures and dispositions that overlap with the area directly disturbed by the Project		Effect extends to current traditional land and resource uses located outside of the LSA to the RSA	Not Applicable	Effect is confined to the RSA	Measured or estimated effect occurs beyond the boundaries of the LSA and mainly within the boundaries of the RSA; the socio-economic assessment may also include impacts at a provincial level within BC, or effects that extend nationally	Effect occurs within the RSA population

Notes: (1) Wildlife = Geographic Extent: Beyond Regional (effects to grizzly bear and caribou because of large regional movement and population extent)
(2) Provincial Extent was used, which only applies to Economy and Social pillars and is defined by "Within British Columbia".



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Table 19.3.3-3: Environment and Heritage Rating Criteria for Characterizing Residual Effects

Rating Criteria	Description										
Context											
Low	VC has strong resilience to stress, the VC has not been affected by other projects or activities or natural changes. No listed species or ecosystems identified										
Medium	VC has moderate resilience to stress, the VC has been affected by other projects or activities, or natural changes but still has capacity to assimilate more changes. Presence of blue-listed species or ecosystems										
High	VC has weak resilience to stress, the VC has been severely affected by other projects or activities, or natural changes. Presence of red-listed or SARA-listed species or ecosystems										
Duration											
Short-term	Less than two years (i.e., effects happens during the construction phase only)										
Medium-term	From two to less than 17 years (i.e., effect happens during construction and operations)										
Long-term	From more than 17 to less than 35 years (i.e., effect happens during construction, operations and closure)										
Chronic (permanent)	More than 35 years and beyond (i.e., effect happens from construction through to post closure and beyond)										
Reversibility											
Yes	Effect is reversible over one to a few cycles of the physical event after the impact ceases (physical). Effect is reversible over one to a few life cycles after the impact ceases (biological)										
No	Effect is not reversible over the time scales listed										
Frequency	•										
Once	Effect occurs on one occasion over the life of the Project										
Intermittent	Effect occurs several times over the life of the Project										
Continuous	Effect occurs continuously over the life of the Project										

Table 19.3.3-4: Economic, Health and Social Rating Criteria for Characterizing Residual Effects

Rating Criteria	Description									
Duration										
Short-term	Effect extends throughout the construction phase									
Medium-term	Not applicable									
Long-term	Throughout operations and closure									
Chronic (permanent)	From construction through post closure or beyond									
Reversibility										
Yes	Baseline conditions can be re-established after the factors causing the effect are removed									
No	Baseline conditions cannot be re-established after the factors causing the effect are removed (i.e., is permanent)									
Frequency										
Once	Effect occurs on one occasion over the life of the Project									
Intermittent	Effect occurs several times over the life of the Project									
Continuous	Effect occurs continuously over the life of the Project									



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19.3.4 Likelihood

The likelihood of occurrence of a particular residual effect is stated before significance has been determined. It is an important element in understanding the potential significance of a residual effect, but it is not a determinant of significance. Likelihood is the certainty of an event occurring and is stated as a probability. Likelihood is rated as a low, moderate, or high likelihood of occurrence.

- Low = residual effect is unlikely to occur or its occurrence could be considered very rare;
- Moderate = it is possible that the residual effect will occur, as it has occurred in other similar projects but not in all projects; and
- High = residual effect is likely or almost certain to occur as it has normally happened in other similar projects.

19.3.5 Significance of Cumulative Effects

Determining the significance of residual adverse cumulative effects is often more complex and challenging than evaluation of direct Project effects because the assessment is much broader, the residual effects of other projects, especially proposed projects, may not have been determined yet or are not well understood, and the ability of one proponent to implement or influence mitigation at this scale is almost always limited. Effective actions to mitigate cumulative effects must be shared with other proponents, agencies, and government, where possible.

For cumulative effects, the approach requires determining the thresholds below which further effects can be sustained by a VC without undergoing changes in condition or state that cannot be reversed with mitigation and/or management. Adverse residual cumulative effects on each VC were determined to be 'significant' or 'Not Significant.' 'Not significant' effects were further categorized as 'negligible', 'minor', or 'moderate' (**Table 19.3.5-1** and **Table 19.3.5-2**).

In general, to be considered to have potential for a significant effect, the residual cumulative effect on the VC being assessed must operate at a regional level and meet one of the following criteria:

- Have a medium magnitude at a regional spatial extent and a long-term or chronic duration; or
- Have a high magnitude at a regional extent of any duration.

Residual cumulative effects on VCs were rated as significant based on magnitude, geographic extent duration, frequency, reversibility, context, and level of confidence.



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Table 19.3.5-1: Example of Use of Environment and Heritage Rating Criteria to Evaluate Significance of Adverse Cumulative Residual Effects

Rating Criteria	Description
Not Significant (negligible)	Effects are point-like or local in geographic extent, or low context rating, and a negligible magnitude, short-term, reversible, and with a low frequency (once or intermittent).
Not Significant (minor)	Effects are local in geographic extent, or low magnitude, or low context rating, short-term to chronic, reversible, or low frequency (once or intermittent).
Not Significant (moderate)	Effects are local to regional in geographic extent, and medium in magnitude, medium context rating, medium-term to chronic, reversible, and occur at all frequencies.
Significant	Effects occur to VCs with a medium to high context rating, high magnitude, regional in geographic extent, long-term to chronic, non-reversible, and occur at all frequencies.

Table 19.3.5-2: Example of Use of Economic and Social Rating Criteria to Evaluate Significance of Adverse Cumulative Residual Effects

Rating Criteria	Description
Not Significant (negligible)	No effects are evident.
Not Significant (minor)	Effects are distinguishable, magnitude is low, geographic extent is local, duration is short-term, reversible, and frequency is intermittent.
Not Significant (moderate)	Effects are clearly distinguishable, magnitude is low to medium, frequency is intermittent, reversible, and duration ranges from usually short-term to long-term.
Significant	Effects are highly distinguishable, high in magnitude, provincial in geographic extent, non-reversible, usually chronic in duration, and frequency is continuous.

19.3.6 Follow-Up Strategy

As may be identified for Project effects, or where a residual effect or a cumulative residual effect has been identified, a follow-up strategy has been developed to:

- Identify the measures required to evaluate the accuracy of the original prediction of effects;
- Identify the measures required to evaluate the effectiveness of proposed mitigation measures; and
- Propose an appropriate strategy to apply in the event that the original predictions of
 effects and mitigation effectiveness are not confirmed. This includes references to further
 mitigation, involvement of key stakeholders, government agencies, and other measures
 that may be necessary to manage the issue.

These strategies are summarized in **Section 13** of the Application.



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19.3.7 Limitations

Each VC in the EA presents assumptions and limitations relative to the assessment of Project effects and the assessment of cumulative effects. The assessment has been conducted in a precautionary manner in order to avoid underestimating residual project effects. Each VC in the EA presents assumptions and limitations relative to the assessment of Project effects and the assessment of cumulative effects. This information has been included in this standalone report.

19.4 VC-Specific Cumulative Effects Assessment

19.4.1 Introduction

The EA assessed the effects of the interaction of the Project activities on the five pillars—environmental, economic, social, heritage, and health components – following the Guideline for Selection of Valued Components and Assessment of Potential Effects (BC EAO, 2013b). Forty specific VCs have been assessed for the Project. Of these, 16 have been identified as having potential for cumulative effects. Eighteen of the forty fall within areas of federal jurisdiction. Of these sixteen, eleven were assessed for cumulative effects (**Table 19.4.2-1**). The CEA for each of the relevant VCs is presented in the following sections.



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Table 19.4.1-1: Summary of Cumulative Effects

		Contributing							Predicted Deg	ree of Effects after	Mitigation				
Valued Component	Area of Federal Jurisdiction ⁽¹⁾	Project Activity or Physical Works / Project Component ⁽²⁾		Potential effects ⁽⁴⁾	Proposed Mitigation ⁽⁵⁾	Residua Effect ⁽⁶⁾	I Magnitude ⁽⁷⁾	Geographic Extent ⁽⁸⁾	Duration ⁽⁹⁾	Frequency ⁽¹⁰⁾	Reversibility ⁽¹¹⁾	Context ⁽¹²⁾	Significance of Residual Adverse Effect ⁽¹³⁾	Likelihood ⁽¹⁴⁾	Confidence ⁽¹⁵⁾
Air Quality		All	С	Changes in concentrations of the substances in the Local Study Area (LSA)	Adhere to the following EMP: • Air Quality and Emissions Management Plan (AQEMP) (Section 12.2.1.18.4.9) monitoring of PM2.5 and PM10	Yes	Low	Regional	Medium-term	Continuous	Reversible	Low	Not Significant (Minor)	High	Moderate
Surface water flow	√	All	CL	Alteration of baseline surface water flow (Upper Eutsuk Lake Watershed) Alteration of baseline surface water flow (Lower Nechako Watershed)	Adhere to the following EMP: Mine Waste Management Plan (MWMP) (Section 12.2.1.18.4.17) Mine Water Management Plan (MWAMP) (Section 12.2.1.18.4.18)	Yes	Negligible	n/a	n/a	n/a	n/a	*Context not applicable	n/a	n/a	n/a
Surface water quality	V	Mine Site	PC	Alteration of baseline surface water quality	Adhere to the following EMP: Water Quality and Liquid Discharges Management Plan (WQLDMP) (Section 12.2.1.18.4.10) Sediment and Erosion Control Plan (SECP) (Section 12.2.1.18.4.1)	Yes	Low	Regional	Chronic	Periodic	Not reported in EA	Low	Not Significant (minor)	Moderate	High
Wetlands	V	All	C, O, CL	Loss of Wetland Extent and Functions	A Wetland Compensation Plan (Appendix 5.3.7A) has been developed for the Project.	Yes	Low	Regional	Long-term	Intermittent	Yes	Medium	Not Significant (minor)	High	Moderate
Physiography and topography		All	PC	Alteration of baseline landscape	Adhere to the following EMP: Sediment and Erosion Control Plan (SECP) (Section 12.2.1.18.4.1) Landscape, Soils and Vegetation Management and Restoration Plan (LSVMRP) (Section 12.2.1.18.4.4) Reclamation and Closure Plan (RCP) (Section 2.6)	Yes	Medium	Local	Chronic	Continuous	Yes	Low	Not Significant (minor)	High	High



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		Contributing							Predicted Deg	gree of Effects after	Mitigation				
Valued Component	Area of Federal Jurisdiction ⁽¹⁾	Project Activity or Physical Works / Project Component ⁽²⁾	Phase (timing) ⁽³⁾	Potential effects ⁽⁴⁾	Proposed Mitigation ⁽⁵⁾	Residual Effect ⁽⁶⁾	Magnitude ⁽⁷	Geographic Extent ⁽⁸⁾	: Duration ⁽⁹⁾	Frequency ⁽¹⁰⁾	Reversibility ⁽¹¹⁾	Context ⁽¹²⁾	Significance of Residual Adverse Effect ⁽¹³⁾	Likelihood ⁽¹⁴⁾	Confidence ⁽¹⁵⁾
Ecosystem composition	1	All	C, O, CL, PC	Ecosystem Loss Nitrogen Deposition Spread of Invasive Plants	Adhere to the following EMP: Sediment and Erosion Control Plan (SECP) (Section 12.2.1.18.4.1) Landscape, Soils and Vegetation Management and Restoration Plan (LSVMRP) (Section 12.2.1.18.4.4) Reclamation and Closure Plan (RCP) (Section 2.6) Invasive Species Management Plan (ISMP) (Section 12.2.1.18.4.5)	Yes	Medium	Regional	Chronic	Once	Mine-related landforms (no) Natural landforms (yes)	Medium	Not Significant (moderate)	High	Moderate
Plant species and ecosystems at risk	V	All	C, O, CL, PC	Ecosystem Loss Nitrogen Deposition Plants Whitebark pine regeneration	Adhere to the following EMP: Landscape, Soils and Vegetation Management and Restoration Plan (LSVMRP) (Section 12.2.1.18.4.4) Reclamation and Closure Plan (RCP) (Section 2.6)	Yes	High	Regional	Chronic	Continuous	Mine-related landforms (no) Natural landforms (yes)	High	Not Significant (moderate)	Moderate	Low
Waterbirds	1	All	C, O, CL, PC	Loss of Waterbird Habitat	Adhere to the following EMP: Landscape, Soils and Vegetation Management and Restoration Plan (LSVMRP) (Section 12.2.1.18.4.4) Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6) Conceptual Wetlands Compensation Plan (Appendix 5.3.7A)		Low	Regional	Long-term	Once	Yes	Medium	Not Significant (minor)	Low	High
Forest and Grassland Birds	V	All	C, O, CL, PC	Loss of Forest and Grassland Bird Habitat	Adhere to the following EMP: Sediment and Erosion Control Plan (SECP) (Section 12.2.1.18.4.1) Landscape, Soils and Vegetation Management and Restoration Plan (LSVMRP) (Section 12.2.1.18.4.4) Reclamation and Closure Plan (RCP) (Section 2.6) Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6)	Yes	Low	Local	Long-term	Once	Yes	Medium	Not Significant (minor)	High	Moderate



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		Contributing						l	Predicted Deg	gree of Effects after	Mitigation		0::		Confidence ⁽¹⁵⁾
Valued Component	Area of Federal Jurisdiction ⁽¹⁾	Project Activity or Physical Works / Project Component ⁽²⁾		Potential effects ⁽⁴⁾	Proposed Mitigation ⁽⁵⁾	Residual Effect ⁽⁶⁾		Geographic Extent ⁽⁸⁾	Duration ⁽⁹⁾	Frequency ⁽¹⁰⁾	Reversibility ⁽¹¹⁾	Context ⁽¹²⁾	Significance of Residual Adverse Effect ⁽¹³⁾	Likelihood ⁽¹⁴⁾	
		All	C, O, CL, PC	Loss of Clark's Nutcracker Habitat	Adhere to the following EMP: Sediment and Erosion Control Plan (SECP) (Section 12.2.1.18.4.1)	Yes	High	Regional	Chronic	Continuous	Yes	High	Not Significant (moderate)	High	Low
					 Landscape, Soils and Vegetation Management and Restoration Plan (LSVMRP) (Section 12.2.1.18.4.4) 										
					Reclamation and Closure Plan (RCP) (Section 2.6)										
					• Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6)										
Moose		All	C, O, CL, PC	Mortality Risk	Adhere to the following EMP: Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6)	Yes	Low	Local	Long-term	Intermittent	Yes	Medium	Not Significant (minor)	High	Moderate
		All	C, O, CL, PC	Change in Movement Patterns	Adhere to the following EMP: Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6)	Yes	Low	Site Specific	Long-term	Intermittent	Yes	Medium	Not Significant (minor)	High	High
		All	C, O, CL, PC	Change in Population Dynamics	, , , ,	Yes	Low	Local	Long-term	Intermittent	Yes	Medium	Not Significant (minor)	High	High
Caribou	٧	All	C, O, CL, PC	Disturbance and mortality; limited impact to caribou Habitat loss and alteration and change in population dynamics, increasing moose and deer habitats	to respond to presence of caribou in proximity to the mine.		High	Regional	Chronic	Continuous	Yes	High	Not Significant (moderate)	Moderate	Moderate
					Adhere to the following EMP: • Landscape, Soils and Vegetation Management and Restoration Plan (LSVMRP) (Section 12.2.1.18.4.4)										
					Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6)										
					Reclamation and Closure Plan (RCP) (Section 2.6)										
Grizzly Bear		All	PC	Habitat Loss and Alteration	Adhere to the following EMP: • Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6)	Yes	High	Regional	Chronic	Continuous	Yes	Medium	Not Significant (minor)	High	Moderate
		All	PC	Mortality Risk	Adhere to the following EMP: Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6)	Yes	High	Regional	Chronic	Continuous	Yes	Medium	Significant	High	Moderate
Furbearers		All	C, O, CL, PC	Loss of Furbearer Habitat	Adhere to the following EMP: Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6)	Yes	Negligible	Local	Chronic	Once	Yes	Medium	Not Significant (minor)	High	High



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		Contributing Project Activity							Predicted De	gree of Effects after	r Mitigation		Significance		
Valued Component	Area of Federal Jurisdiction ⁽¹⁾	or Physical Works / Project	Phase (timing) ⁽³⁾	Potential effects ⁽⁴⁾	Proposed Mitigation ⁽⁵⁾	Residual	Magnitude ⁽⁷⁾	Geographic Extent ⁽⁸⁾	Duration ⁽⁹⁾	Frequency ⁽¹⁰⁾	Reversibility ⁽¹¹⁾	Context ⁽¹²⁾	of Residual Adverse Effect ⁽¹³⁾	Likelihood ⁽¹⁴⁾	Confidence ⁽¹⁵⁾
		All	C, O, CL,	Beaver Mortality	Adhere to the following EMP:	Yes	Negligible	Local	Long-term	Intermittent	Yes	Low	Not Significant	Low	High
			PC		Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6)								(minor)		
Invertebrates		All	C, O, CL,	Loss of Invertebrate Habitat	Adhere to the following EMP:	Yes	Low	Local	Chronic	Once	Yes	Medium	Not Significant	High	Medium
			PC		Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6)								(minor)		
Non-traditional		All	C, O, CL	Recreation and Tourism -	Adhere to the following EMP:	Yes	Low	Regional	Long-term	Intermittent	Yes	Neutral	Not Significant	Moderate	Moderate
land and resource use					Transportation and Access Management Plan (TAMP) (Section 12.2.1.18.4.14)								(minor)		
					 Landscape, Soils and Vegetation Management and Restoration Plan (LSVMRP) (Section 12.2.1.18.4.4) 										
					• Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6)										
			C, O, CL	Mining, Prospects, Exploration,	Adhere to the following EMP:	Yes	Low	Regional	Long-term	Continuous	Yes	Neutral	Not Significant	Moderate	Moderate
				Quarries, Gravel Pits and Mineral Tenures	Transportation and Access Management Plan (TAMP) (Section 12.2.1.18.4.14)								(minor)		
					 Landscape, Soils and Vegetation Management and Restoration Plan (LSVMRP) (Section 12.2.1.18.4.4) 										
					Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6)										
		All	C, O, CL	Forestry and Timber Resources	Adhere to the following EMP:	Yes	Low to	Regional	Long-term	Continuous	Yes	Neutral	Not Significant	Moderate	Moderate
					Transportation and Access Management Plan (TAMP) (Section 12.2.1.18.4.14)		Moderate						(minor)		
					 Landscape, Soils and Vegetation Management and Restoration Plan (LSVMRP) (Section 12.2.1.18.4.4) 										
					• Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6)										
		All	C, O, CL	Hunting, Trapping, and Guide	Adhere to the following EMP:	Yes	Low	Regional	Long-term	Continuous	Yes	Neutral	Not Significant	Moderate	Moderate
				Outfitting	Transportation and Access Management Plan (TAMP) (Section 12.2.1.18.4.14)								(minor)		
					Landscape, Soils and Vegetation Management and Restoration Plan (LSVMRP) (Section 12.2.1.18.4.4)										
					Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6)										



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		Contributing							Predicted De	gree of Effects after	Mitigation				
Valued Component	Area of Federal Jurisdiction ⁽¹⁾			Potential effects ⁽⁴⁾	Residua Proposed Mitigation ⁽⁵⁾ Effect ⁽⁶⁾		Geographic Extent ⁽⁸⁾	: Duration ⁽⁹⁾	Frequency ⁽¹⁰⁾	Reversibility ⁽¹¹⁾	Context ⁽¹²⁾	Significance of Residual Adverse Effect ⁽¹³⁾	Likelihood ⁽¹⁴⁾	Confidence ⁽¹⁵⁾	
		All	C, O, CL	Agriculture and Range Land Tenures	Adhere to the following EMP: Transportation and Access Management Plan (TAMP) (Section 12.2.1.18.4.14) Landscape, Soils and Vegetation Management and Restoration Plan (LSVMRP) (Section 12.2.1.18.4.4) Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6)	Yes	Negligible to low	Regional	Long-term	Continuous	Yes	Neutral	Not Significant (negligible)	Moderate	Moderate
		All	C, O, CL	Land Ownership (Private Lands)	Adhere to the following EMP: Transportation and Access Management Plan (TAMP) (Section 12.2.1.18.4.14) Landscape, Soils and Vegetation Management and Restoration Plan (LSVMRP) (Section 12.2.1.18.4.4) Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6)	Yes	Low	Regional	Long-term	Continuous	Yes	Neutral	Not Significant (minor)	Ü	High
		All	C, O, CL		 Adhere to the following EMP: Transportation and Access Management Plan (TAMP) (Section 12.2.1.18.4.14) Landscape, Soils and Vegetation Management and Restoration Plan (LSVMRP) (Section 12.2.1.18.4.4) Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6) 	Yes	Low	Regional	Long-term	Continuous	Yes	Neutral	Not Significant (minor)	Moderate	Moderate
Current Land and Resource Use for Traditional Purposes	V	Mine Site, Mine Access Road, Airstrip and Freshwater Supply System	C, O, CL, PC	LDN Hunting	Adhere to the following EMP: Wildlife Management Plan (WLMP) (Section 12.2.1.18.4.6) Landscape, Soils and Vegetation Management and Restoration	Yes	Medium	Regional	Chronic	Continuous	Yes	High	Not Significant (moderate)	High	Moderate
				LDN Trapping (TR0512T014)	Plan (LSVMRP) (Section		High	Local	Chronic	Continuous	Yes	High	Significant	High	Moderate
				LDN Plant harvesting	12.2.1.18.4.4)		Medium	Regional	Chronic	Continuous	Yes	High	Not Significant (moderate)		Moderate
				UFN Hunting			Medium	Regional	Chronic	Continuous	Yes	High	Not Significant (moderate)		Moderate
				UFN Trapping			Medium	Regional Regional	Chronic Chronic	Continuous	Yes	High	Not Significant (moderate) Not Significant		Moderate Moderate
				UFN Plant harvesting			Medium	Tregional	Officials	Continuous	163	High	(moderate)	i iigii	woderate



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		Contributing							Predicted Deg	ree of Effects after N	litigation		0::		
Valued Component	Area of Federal Jurisdiction ⁽¹⁾	Project Activity or Physical Works / Project Component ⁽²⁾		Potential effects ⁽⁴⁾	Proposed Mitigation ⁽⁵⁾	Residual		Geographic Extent ⁽⁸⁾	Duration ⁽⁹⁾	Frequency ⁽¹⁰⁾	Reversibility ⁽¹¹⁾	Context ⁽¹²⁾	Significance of Residual Adverse Effect ⁽¹³⁾	Likelihood ⁽¹⁴⁾	Confidence ⁽¹⁵⁾
Visual resources		Mine Site, Transmission Line, Kluskus FSR	C, O, CL	Visual Disturbance: Stellako River Cheslatta Trail Nechako River Valley Brewster Lake	Adhere to the following EMP: Visual Resources and Aesthetics Management Plan (VRAMP) (Section 12.2.1.18.4.8)	Yes	Low	Local	Long-term	Intermittent	Yes	Neutral	, ,	High Moderate - Brewster Lake	Moderate Low - Brewster Lake
		Mine Site, Transmission Line, Kluskus FSR	C, O, CL, PC	Visual Disturbance: Tatelkuz Lake	Adhere to the following EMP: Visual Resources and Aesthetics Management Plan (VRAMP) (Section 12.2.1.18.4.8)	Yes	Medium	Local	(permanent)	Continuous - Tatelkus Lake Southeast Recreation Reserve Frequent – Dykam Ranch, Tatelkus Lake IR 28	No	Neutral	Not Significant (moderate)	High	High

Note:

*Context not applicable - *Refer to the EA sections dependent on surface water flow for ecological context

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[&]quot;-" not used in the assessment.

⁽¹⁾ Indicate by a check mark which valued components can be considered "environmental effects" as defined in section 5 of CEAA, 2012, and specify which subsection of CEAA, 2012 is relevant. For example, for the VC "Use of land and resources by Aboriginal people", the appropriate cell would indicate, section 5(1)(c)(iii).

⁽²⁾ Contributing Project Activity or Physical Works / Project Components: Mine site; Transmission line; Proposed Transmission Line – Mills Ranch Re-route; Proposed Transmission Line – Stellako River Re-route; Mine access road; Airstrip; Freshwater supply pipeline; Project Access Road (Kluskus FSR)

⁽³⁾ Phase (timing): C= construction; O = operations; CL = closure; PC = post-closure; BOLD: indicated period of maximum effect

⁽⁴⁾ Potential effects: Potential Project effects are assessed quantitatively or qualitatively as appropriate to the nature of the indicator and/or factor selected for each VC. Limitations and assumptions for models used to quantitatively estimate Project effects have been clearly stated for each VC.

⁽⁵⁾ Proposed mitigation: Mitigation includes any action taken to avoid, minimize, restore on-site, compensate, or offset the adverse effects of a project or activity

⁽⁶⁾ Residual effect: Yes; No

⁽⁷⁾ Magnitude: Negligible; Low; Medium; High

⁽⁸⁾ Geographic Extent: Point: 100 m²; Site-Specific: Within the Project Site; Local: Within LSA; Regional: Within the RSA

⁽⁹⁾ Duration: Short-term; Medium-term; Long-term; Chronic (permanent)

⁽¹⁰⁾ Frequency: Once; Intermittent; Continuous

⁽¹¹⁾ Reversibility: Yes; No

⁽¹²⁾ Context: Low; Medium; High; neutral

⁽¹³⁾ Significance of residual adverse effect: Not Significant (negligible); Not Significant (minor); Not Significant (moderate); Significant

⁽¹⁴⁾ Likelihood: Low; Moderate; High

⁽¹⁵⁾ Confidence: High; Moderate; Low

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19.4.2 Environmental VCs

19.4.2.1 Air Quality

Based on the criteria described in **Section 4.3.5** of the Application, a CEA for air quality is required if:

- The occurrence of a residual adverse Project effect has been determined, but this
 residual effect is not expected to be negligible; and
- The residual Project effects are demonstrated to interact with the effects of other past, present or future projects, or activities.

In that same section the following major projects were initially identified as possible candidates for inclusion in the assessment of cumulative effects:

- Nulki Hills Wind Project;
- · Coastal Gas Link Pipeline; and
- Pacific Gas Looping Project.

Residual air quality effects are limited to the air quality LSA and the above listed projects all occur entirely outside the LSA. As these projects do not meet the second criteria above (Project effects interact with the effects of other projects) they are not considered to contribute to any cumulative effects.

Also listed in **Section 4** (Assessment Methodology) are the following general land uses that should be reviewed to determine the potential contribution to cumulative effects:

- Protected areas and parks;
- Recreation/tourism use (e.g., all terrain vehicle use);
- Mining, exploration, and mineral tenures;
- Forestry and timber resource use;
- Hunting/trapping/guide outfitting;
- Fishing and aquaculture;
- Agriculture and grazing;
- Range use;
- Land ownership and tenures;
- Recreational and commercial use of waterways;
- · Groundwater resource use; and
- Surface water resource use.



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The activities determined to contribute to cumulative air quality effects are those with combustion emissions or vehicle traffic as these activities may generate air emissions such as TPM, $PM_{2.5}$, CO and NO_x that interact with the Project. Of the above listed general land uses, mining exploration and forestry resource are the activities that may make the largest cumulative effects contribution to air quality. However, these other activities are not creating measurable changes in the air quality RSA as shown by the very low baseline contaminants concentrations.

In order to quantify cumulative air quality effects it is necessary to obtain spatially and temporally specific activity information so that emissions can be estimated and assigned to a specific geographic area. By their nature forestry resource use and mining exploration are activities that move continuously and have a relatively low level of activity in any specific location over a significant period of time. Therefore their interaction with Project air quality effects tends to be lower than an activity that remains in one location for a longer period of time.

Detailed activity information with any meaningful degree of confidence is not available for either activity so the only assessment possible is qualitative in nature. The level of forestry and mining exploration in the RSA is assumed to be small relative to the level of vehicle activity expected to be generated by the project. As these activities currently occur, their air quality impacts are already being included in the Project assessment by the addition of a background value. Therefore the cumulative effects are considered to be Not Significant at a minor level as presented in **Table 19.4.2-1**.

Table 19.4.2-1: Determination of Significance of Cumulative Effects for Air Quality

Category	Rating	Comment
Context	Low	The VC has no existing sensitivities and is anticipated to be resilient to effects of the Project and cumulative activities.
Magnitude	Low	Changes in predicted ground-level concentrations between the project alone and cumulative scenarios are anticipated to be minimal as cumulative activities do not occur where maximum project effects are predicted (at Project boundary).
Extent	Regional	Predicted AQ cumulative effects are assessed in the AQRSA.
Duration	Medium-term	Effects will end shortly after Project operations.
Frequency	Continuous	Project and cumulative activity emissions are assumed to be continuous during the Project duration.
Reversibility	Reversible	Project effects stop occurring shortly after Project closure, effects due to cumulative activities may continue after Project closure.
Likelihood	High	Similar effects are seen at many projects and the Project and cumulative activities is not expected to be significantly different.
Confidence for Likelihood	High	Similar effects are seen at many projects and the Project and cumulative activities is not expected to be significantly different.
Significance Determination	Not Significant (Minor)	Cumulative effects are regional, reversible, and of low magnitude.
Confidence for Significance Determination	Moderate	Modelling tends to provide over-predictions of effects due to conservative assumptions in methodology. Air quality related information with any meaningful degree of confidence on cumulative activities is not available and these can be assessed in a qualitative manner only.

Note: AAQO = Ambient Air Quality Objectives; AQ = Air Quality; VC = Valued Component



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19.4.2.1.1 **Limitations**

Dispersion modelling has inherent limitations due to simplifications required to reduce the data processing to a level that can be handled with current technology. These limitations are described in detail in Section 8 of the Air Quality Modelling Report found in **Appendix 5.2.4A** of the Application. The assumptions and limitations made in modelling tend towards conservatism and over-prediction of ambient values.

19.4.2.1.2 Conclusion

The results in **Section 5.2.4** predict potential exceedances of ambient objectives for PM_{2.5}, PM₁₀ and TSP. These exceedances are infrequent, cover a small area in an area of relatively low accessibility. The inherent conservatism present in the assessment technique (dispersion modelling) suggests that these exceedances are potentially assessment artifacts and unlikely to occur during project activities. Therefore this effect is assessed as Not Significant.

To confirm the above assumptions, it is recommended that monitoring of $PM_{2.5}$ and PM_{10} be conducted during construction and operations to confirm the air quality predictions. TSP levels can be estimated based on PM_{10} monitoring as has been done previously for the Project. Emissions of other substances from the Project are not considered significant and monitoring and follow-up for those substances are not recommended.

19.4.2.2 Surface Water Flow

A CEA for the Surface Water Flow VC is necessary because when all of the residual effects rating metrics are considered (**Section 5.3.2.4** of the Application), the residual effects of the Project (after mitigation that includes meeting IFN in Davidson Creek) on the watersheds are expected to be "Not significant (moderate)". Therefore, the VCs of surface water flow at Chedakuz Creek (WN H5) and Creek 705 (WMN 1-705) are carried forward into the cumulative effects assessment as summarized in **Table 19.4.2-2**. In addition, as surface water flow is an intermediate component in the effects pathway, the results herein are carried forward into other aquatics-related VCs such as fish and fish habitat.



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Table 19.4.2-2: Surface Water Flow Project Related Residual Effects; Rationale for Carrying Forward into the CEA

Project Component	Project Phase	Residual Effect	Rationale	Carried Forward in Cumulative Effects Assessment
Chedakuz Creek (WN H5)	D/C	Alteration of baseline surface water flow.	Potential to decrease flows in the Chedakuz Creek Watershed, which would carry into the RSA.	Yes
Creek 705 (WMN 1- 705)	D/C	Alteration of baseline surface water flow.	Potential to increase flows in the Creek 705 Watershed, which would carry into the RSA.	Yes

Note: D/C = decommissioning and closure.

Cumulative effects are interactions between predicted residual effects from the Project that have the potential to combine cumulatively with residual effects from other past, present, or reasonably foreseeable future projects.

Past land use in the Project area includes mining, exploration, agricultural, recreational and forestry activities in addition to Aboriginal traditional use. The effects of these activities on the existing watersheds are included in the baseline conditions and are therefore reassessed as potential cumulative effects with the Project on surface water flow in the Aquatics RSA (**Section 5.3.2** of the Application).

Present and future land use in the Project area that could potentially affect surface water flow include agriculture, forestry, and mining. For the purposes of the Surface Water Flow VC, the Aquatics RSA is divided into two major areas (**Figure 19.4.2-1**): the Upper Eutsuk Regional Watershed (includes the Creek 705 Watershed) and the Lower Nechako Regional Watershed (includes the Creek 661, Turtle Creek, Davidson Creek, and Chedakuz Creek Watersheds and Tatelkuz Lake).

Table 19.4.2-3 shows the major watershed components within the Aquatics RSA for the assessment of potential cumulative effects of present and future projects with the Project for the Surface Water Flow VC.

The potential effects on surface water flow from agriculture, forestry, and mining within the Aquatics RSA were estimated based on change in weighted runoff coefficient. The runoff coefficient for natural drainage in the Aquatics RSA is estimated to be 0.31 as is discussed in the Hydrology Baseline summary section of the EA (**Section 5.1.2.1** of the Application). Current and future agricultural, forestry, and mining activities in the Aquatics RSA would change this runoff coefficient. It has been assumed for this assessment that agricultural activities would reduce the runoff coefficient to 0.2 and that forestry and mining would increase the runoff coefficient to 0.5 (Watt et al., 1989).



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Table 19.4.2-3: Major Watershed Components of the Aquatics RSA

Watershed Component	Total Area (ha)
Upper Eutsuk Lake Regional Watershed component – includes Creek 705 Watershed	46,300
Lower Nechako Regional Watershed component – includes Chedakuz Creek, Creek 661, Turtle Creek and Davidson Creek Watersheds and Tatelkuz Lake	94,189
Subtotal	140,489
Remainder of RSA (Transmission Line and Kluskus Access Road components)	5,959
Total Aquatic RSA	146,448

Note: ha = hectare

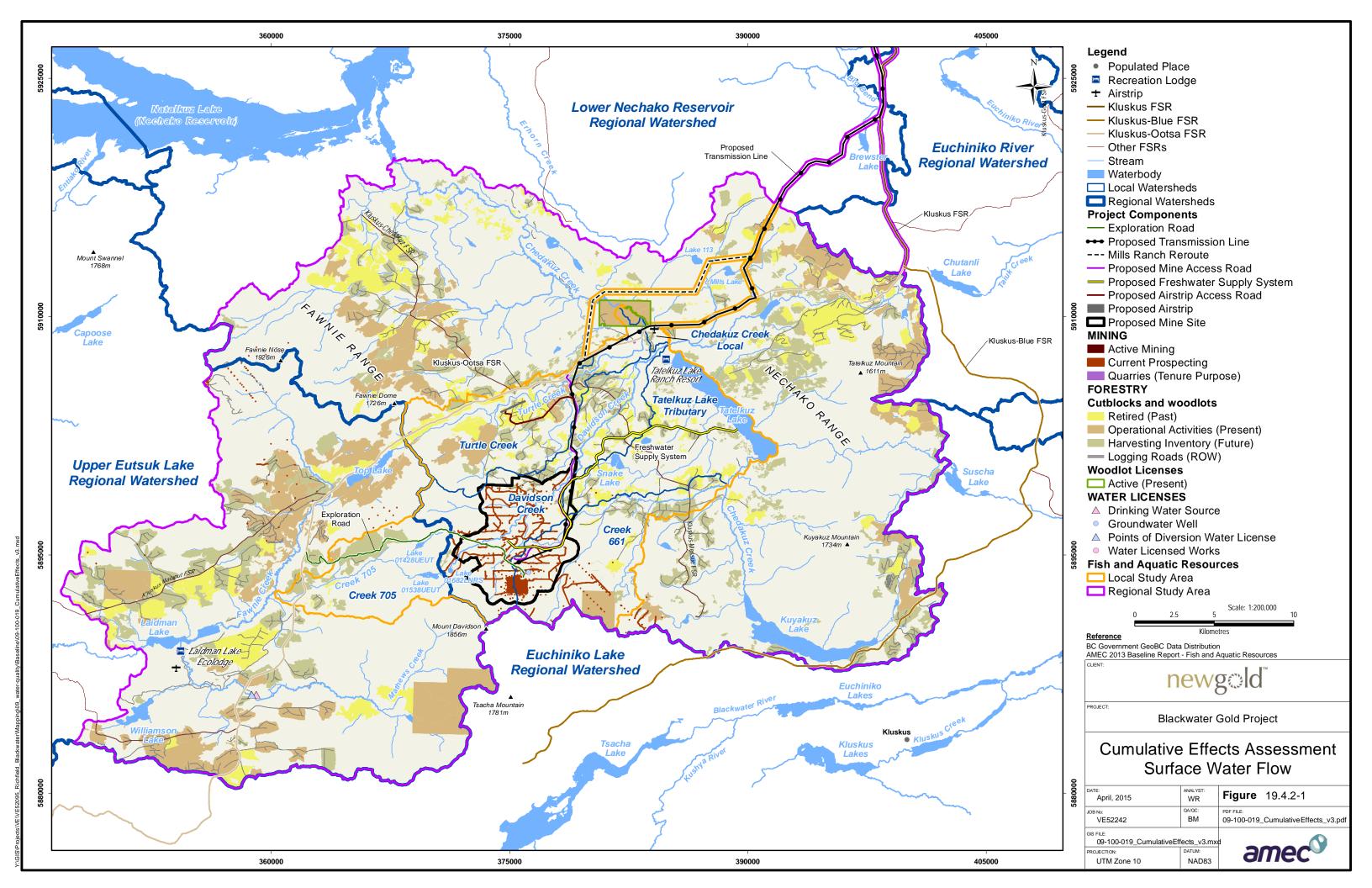
It was estimated that these current and future activities could increase the baseline weighted runoff coefficient of the Upper Eutsuk Lake (includes the Creek 705 Watershed) component of the Aquatics RSA from 0.31 to 0.37. For post-closure, it is estimated that the Project could increase this weighted runoff coefficient to 0.38. Therefore, the contribution of the Project to the cumulative effects of current and future activities in the Upper Eutsuk Lake component of the Aquatics RSA is 2.5%, which is less than 5% and considered not to be measurable and therefore negligible. The residual cumulative effects assessment for surface water flow in the Upper Eutsuk Lake Watershed is summarized in **Table 19.4.2-4.**

Table 19.4.2-4: Residual Cumulative Effects Assessment for Surface Water Flow in the Upper Eutsuk Lake Watershed

Effect Attribute	Current / Future Cumulative Effect(s) without Project	Cumulative Effect(s) with Project
Context	*Context not applicable	*Context not applicable
Magnitude	Medium	Negligible
Geographic extent	Regional	n/a
Duration	Chronic	n/a
Reversibility	No	n/a
Frequency	Continuous	n/a
Likelihood Determination	High	n/a
Level of confidence for Likelihood	High	n/a
Significance Determination	Not Significant (moderate)	n/a
Level of confidence for Significance	Low	n/a

Note: n/a = not applicable as it was determined from this assessment that the effects are not measurable and therefore negligible and not carried forward into this assessment.





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It was estimated that these current and future activities could increase the baseline weighted runoff coefficient of the Lower Nechako (includes the Chedakuz Creek, Creek 661, Turtle Creek and Davidson Creek Watersheds and Tatelkuz Lake) component of the Aquatics RSA from 0.31 to 0.36. For post-closure, it is estimated that the Project could decrease this weighted runoff coefficient to 0.35. Therefore, the contribution of the Project to the cumulative effects of current and future activities in the Lower Nechako component of the Aquatics RSA is -1.7% which is less than 5% and considered not to be measurable and therefore negligible. The residual cumulative effects assessment for surface water flow in the Lower Nechako Watershed is summarized in **Table 19.4.2-5.**

Table 19.4.2-5: Residual Cumulative Effects Assessment for Surface Water Flow in the Lower Nechako Watershed

Effect Attribute	Current / Future Cumulative Effect(s) without Project	Project Contribution Cumulative Effect
Context	*Context not applicable	*Context not applicable
Magnitude	Medium	Negligible
Geographic extent	Regional	n/a
Duration	Chronic	n/a
Reversibility	No	n/a
Frequency	Continuous	n/a
Likelihood Determination	High	n/a
Level of confidence for Likelihood	High	n/a
Significance Determination	Not Significant (moderate)	n/a
Level of confidence for Significance	Low	n/a

Note: n/a = not applicable as it was determined from this assessment that the effects are not measurable and therefore negligible and not carried forward into this assessment.

Figure 19.4.2-2 shows the current surface water licences near the Project. There are two current surface water licences in the Upper Eutsuk Lake component of the Aquatics RSA; one is a drinking water source and the other is a point of water diversion. Both of these licences are located on Matthews Creek, a tributary of Fawnie Creek, upstream of Laidman Lake. The Creek 705 Watershed is located in the upper extents of the Upper Eutsuk Lake Watershed. As can be seen in **Section 5.3.2.3** of the Application, the Project is expected to increase surface water flows in the Creek 705 Watershed. This is due to the fact that drainage will be permanently diverted from the Davidson Creek Watershed to the Creek 705 Watershed. These increases will have no effect on these two surface water licences, as they are located on a tributary upstream of Fawnie Creek.

Cumulative effects were assessed for the Surface Water Flow VC. When compared to the potential effect of current and future agricultural, forestry, and mining activities in the Aquatics RSA, the Project effects on surface water flow are expected not to be measurable and therefore negligible.



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19.4.2.2.1 **Limitations**

The Project residual effects of the flows were assessed to determine the cumulative effects based on both modelling results and the effects on runoff coefficients due to changes in land use and other activities. The model outcome and the estimation of the runoff coefficients have uncertainties due to the model assumptions and the variability in runoff coefficients.

19.4.2.2.2 Conclusions

Surface water flow was selected as a VC for the Project EA because changes to surface water flows could affect surface water and sediment quality, fish and fish habitat, groundwater quantity and quality, and wetlands. The watersheds assessed for potential effects from the Project on the Surface Water Flow VC include Turtle Creek, Davidson Creek, Creek 661, Creek 705, and lower Chedakuz Creek (contains Tatelkuz Lake). These watersheds are either within or adjacent to the Project footprint. Hence, the Project has the potential to affect surface water flow in these watersheds.

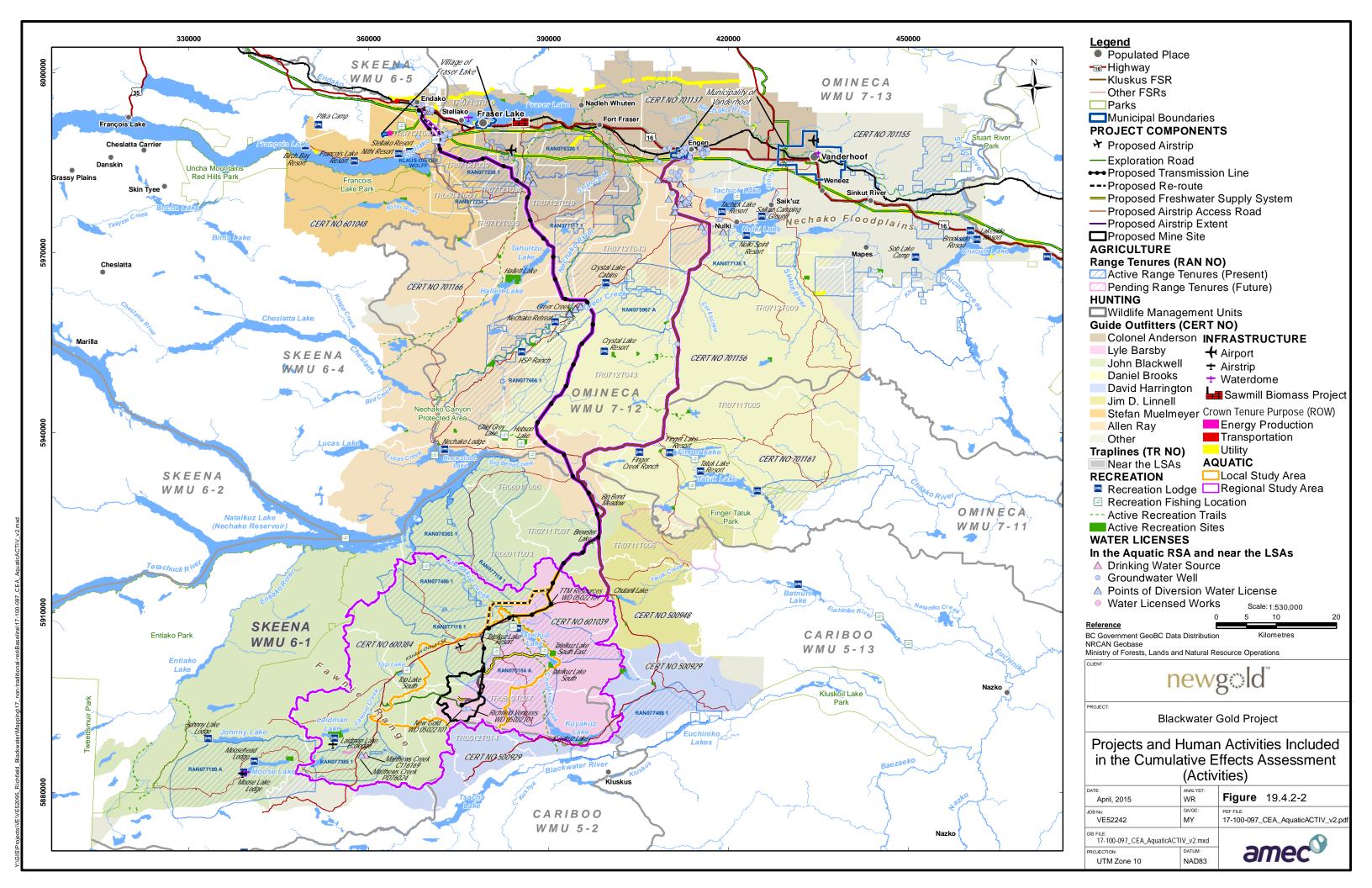
It was determined in this assessment that surface water flows in the Turtle Creek watershed are not expected to be affected by the Project. In addition, the potential effects of the proposed airstrip, access roads, and transmission line within the Aquatics RSA are expected to be negligible. The Project access road (Kluskus FSR) will not traverse the Aquatics LSA or the Aquatics RSA for the Project and was therefore not included in the assessment of surface water flow.

Nevertheless, effects on some of the mean annual, peak, and low flows in the Davidson Creek, Creek 661, Creek 705, and Chedakuz Creek Watersheds are not expected to be negligible (with mitigation measures including meeting IFN in Davidson Creek) and will have residual effects. Therefore, the significance of these residual effects on surface water flow is assessed.

Surface water flows can naturally range between highs and lows with no expected significant effects on the natural environment. When all of the residual effects significance rating metrics are considered, the residual effects of the Project (with mitigation measures including meeting IFN in Davidson Creek) on the above watersheds are expected to be "Not significant (moderate)." Potential cumulative effects for these residual effects of the Project, considering other past, present (including water licences), or reasonably foreseeable future projects, are assessed and the Project contribution is considered negligible.

The hydrological indicators of surface water flow of the Surface Water Flow VC also play a critical role in surface water and sediment quality, fish and fish habitat, groundwater quantity and quality, and wetlands. Therefore, the extent to which surface water flow is affected is an important factor to how other VCs are affected. Therefore, other potentially affected VCs took the effects on surface water flow into account during their assessments.





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19.4.2.3 Surface Water Quality

Logging has occurred in the watersheds where the Project is located. Logging typically leads to increased TSS in streams and potentially changes in nutrient concentrations of nutrients are washed more rapidly from the exposed soils after logging. Since logging occurred prior to water quality monitoring at the site, any effects are already included in the baseline data collected.

A ranch is located near the mouth of Davidson Creek and could potentially be having some effect on both Davidson and lower Chedakuz creeks. As the ranch was in operation before water monitoring commenced for the Project, it is not possible to separate any effects ranch operation may have on water quality of the subject creeks. Effects could include nutrient addition from cattle manure and sedimentation from cattle entering either creek. Since BC FWGs for these parameters were not exceeded at any of the monitoring sites close to the ranch, any effects that might possibly be occurring are not above concentrations considered potentially harmful to aquatic life.

Exploration activities for the Project result in land disturbance, which could potentially have affected water quality in adjacent streams. The Proponent developed and successfully implemented approved environmental management plans for their exploration license. Access trails and drill pads require reclamation under the license, which is carried out usually within a year or less of completion of site disturbance. Reclamation activities are inspected periodically by MEM and have been found to be satisfactory. Water quality monitoring from 2011 through 2013 has not indicated any increases in TSS that could be correlated with adjacent tote trails, exploration roads, or drill pads. Therefore, there is unlikely to be any water quality cumulative effects from exploration activities that pre-date Project construction.

In the RSA, the principal users of the FSR are, and will continue to be, forest companies. Cumulative effects could occur from dust deposition in streams crossed by the shared roads. Dust deposition in fish-bearing waters, if extreme, could possibly lead to sediment accumulation, which could negatively affect fish habitat. In practice, dust will be fine and be carried away from the road area and slowly sediment out of the water column. With dust controls in place (e.g., road dressing), contributions from traffic dust to sediment in crossed streams are expected to be minor compared to watershed sediment export upstream of the road crossing. Changes in sediment quality from road dust will be unmeasurable, and in any case, inseparable from upstream changes.

Pacific Northern Gas Ltd. is proposing a natural gas transmission pipeline between Summit Lake, BC, and Kitimat, BC. The Project at the time of writing of this report was in the pre-application phase of the BC environmental assessment process. Based on the information provided in the pre-application, the gas line would cross the Stellako River, which would also be crossed by the proposed transmission line. With best management practices proposed for construction of the transmission line and the ability to site transmission towers well away from water crossings, no sedimentation into the Stellako River is anticipated by transmission line construction and therefore, no cumulative effect combined with the gas pipeline proposal.

Possible ranching activities effects on Davidson and Chedakuz creeks pre-dating the Project are already factored into the background monitoring results.



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There are no other possible sources in the LSA (Project proposed watersheds) or RSA (including the Kluskus FSR and proposed transmission line) that could contribute residual effects outside of the background range for measured parameters. A former proposed mine project, Chu Moly, was withdrawn from the assessment process. There is extensive exploration activity in the RSA but no projects that have entered the project approval process and thus it is unknown whether any future mining or other project could be developed prior to closure of the Blackwater Mine. Therefore, there will be no significant cumulative effects from the Project and other sources of contamination on water quality.

The significance of residual Project effects on water quality is listed in **Table 19.4.2-6**. Categories are defined in **Section 4.7** of the Application.

Table 19.4.2-6: Significance of Cumulative Project Effects on Water Quality

Categories for	Project Phase					
Significance Determination	Construction	Operations/Closure	Post-Closure			
Context	n/a	n/a	low			
Magnitude	n/a	n/a	low			
Geographic Extent	n/a	n/a	regional			
Duration	n/a	n/a	chronic			
Frequency	n/a	n/a	periodic			
Likelihood	n/a	n/a	moderate			
Significance Determination	n/a	n/a	Not Significant – minor			
Confidence	n/a	n/a	high			

19.4.2.3.1 **Limitations**

The assessment of water quality potential effects was based on empirical data and quantitative modelling results. However, all source terms derived from empirical data were subject to some uncertainty. Several models were used to provide inputs to the Goldsim™ water quality model, which in themselves had some uncertainty. In general, source models used conservative assumptions. These source models included:

- A pit lake water quality prediction model;
- PHREEQC for chemical equilibrium of open pit pH;
- SEEPW for tailings seepage;
- MODFLOW for general groundwater flows at the mine site;
- Goldsim[™] for mine site hydrology; and
- Site-wide watershed model (developed by Knight Piésold) for watershed water balance.

Overall certainty is high (estimated at >90%) for the best estimate water quality effects model, and worst case assumptions were combined into a separate model scenario, but monitoring of surface



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water quality trends will be required to determine the accuracy of predictions, particularly for parameters that are naturally near or above BC FWG.

19.4.2.3.2 Conclusions

All parameters with BC FWG, CCME protection of aquatic life, BC/Health Canada drinking water guidelines and BC protection of wildlife guidelines were modelled and discussed in the environmental assessment.

The last year of construction (assumed to represent baseline conditions), operations, closure and post closure were modelled. Operations and closure were grouped for evaluation because the fundamental water management at the Blackwater Mine will not change during the approximately 18-year closure period when the pit lake is filled.

With the exception of background parameters above guidelines and possibly sulphate under the post closure worst-case scenario, all parameters are predicted to remain below all guidelines. Predicted exceedances for dissolved sulphur are relatively small, and assume no sulphate reduction in the TSF or wetlands, and are thus likely high.

None of the projects or activities in the PIL (**Table 19.3.2-1**) has the potential to increase sulphate concentrations in Davidson Creek. These projects and activities will not act cumulatively with the Project and a CEA is not required.

Planned and future projects and activities that could act cumulatively to increase sediment loads (TSS) in streams during the construction and operations phases include the Pacific Gas Looping Project, logging, and mining exploration. Given the implementation of BMPs, a cumulative increase in sediment loads (TSS) in streams during the construction and operations phases of the Project is predicted to be Not Significant (negligible).

19.4.2.4 Wetlands

19.4.2.4.1 Rationale for Assessing Cumulative Effects

A CEA for the Wetlands VC is necessary because the Project is expected to have a Not Significant (moderate) residual adverse effect on wetland extent and functions. Residual effects on wetland extent and functions that could arise from other projects or activities in the region should be assessed to fully understand the context of the residual adverse effects on the wetlands VC by the Project. The spatial boundary for this assessment is the RSA. The temporal boundaries include historical, present, and certain and reasonably foreseeable projects within the RSA.

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

For the Wetlands VC CEA, the most relevant land uses in the RSA that could potentially interact with wetland ecosystems include forestry, mining, and agriculture. No singular reviewable projects were identified within the RSA. Current mineral prospecting could lead to mine projects in the



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future, but hypothetical projects are not to be considered during the CEA (BC EAO, 2013). Identified interactions between past, present, and future projects and land uses in the RSA for the CEA are presented in **Table 19.4.2-7**.

Table 19.4.2-7: Interactions between Wetlands VC and other Past, Present, and Future Projects/Activities

	Representative Current and Historical Land Use Future Land Use					
Potential Residual Effect	Forestry (cut blocks and woodlots)	Agriculture (range tenures	Mining (active, current prospecting, quarries)	Forestry (cut blocks and woodlots)	Agriculture (active range tenures)	Carried Forward into CEA?
Loss of Wetland Function	I	I	I	I	I	Yes

Note: I = interaction, KI = key interaction, NI = no interaction

Forestry-related activities in the RSA have the potential to temporarily alter and degrade wetland functions through habitat conversion, noise pollution, erosion and sedimentation, and invasive species introduction. Although forestry activities do not typically result in loss of wetland extent, the temporary effects on wetlands from current and future forestry activities could result in the temporary degradation of wetland functions. Habitat conversion results from removing the overstory in multi-strata forested wetland habitats.

Agricultural activities in the RSA also have the potential to degrade wetland functions. Cattle grazing can alter wetland vegetation cover in emergent habitats, and potentially introduce invasive vegetation species. Trampling can compact wetland soils and cause erosion in riparian areas resulting in sedimentation of surface waters. Mechanical harvesting of wetland vegetation can cause rutting and soil displacement. Farms and other agricultural operations can result in reduced water quality in wetlands through fertilizer and pesticide use. Similar to forestry activities, agricultural activities do not typically result in the loss of wetland extent but may result in degraded wetland functions.

Mining activities (e.g., current prospecting, exploration) are occurring southeast and northwest of the mine site, and are likely to continue into the future. Mineral prospecting can result in degraded wetland functions through accidental discharge of drilling fluids, noise pollution, and vegetation removal. Negligible loss of wetland extent is possible due to temporary access road construction.

19.4.2.4.3 Potential Residual Cumulative Effects and Mitigation Measures

A Wetland Compensation Plan (**Appendix 5.3.7A** of the Application) has been developed for the Project. Approximately 305 ha of wetlands will be created in the mine site to mitigate the loss of



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309.3 ha of wetlands and wetland hydrological, biochemical, and habitat functions. An additional 52.3 ha of wetland compensation will be provided for the loss of Blue-listed wetland ecosystems.

The Proponent is committed to following mitigation measures provided in the guidance document *Wetland Ways: Interim Guidelines for Wetland Protection and Conservation in British Columbia* (Cox and Cullington, 2009) to minimize adverse effects on wetland functions. If forestry, agricultural, and mineral prospecting practitioners in the RSA follow this guidance, then potential degraded wetland functions resulting from these activities can be successfully mitigated through avoidance and minimization.

Suggested mitigation measures for forestry activities include: 1) maintaining drainage pathways and wetland hydrology by installing appropriately sized culverts for stream and wetland crossings; 2) avoiding harvesting in wetland and riparian areas; and 3) replanting native vegetation to expedite succession. These mitigation activities are already included in the Environmental Management Plans for the Project (Section 12.2.1 of the Application).

Suggested mitigation measures for agricultural activities include: 1) establishing cattle exclusion zones to limit grazing to uplands, thereby minimizing erosion and sedimentation; 2) minimizing pesticide and fertilizer use around aquatic resources and before precipitation events to limit chemical runoff from entering wetlands; 3) establishing protected riparian areas prior to clearing; and 4) controlling invasive species.

Suggested mitigation measures for mineral exploration and prospecting, which are typical permit conditions under the *Mines Act* (Government of BC, 1996), include: 1) pre-planning to avoid wetlands and minimizing stream crossings for access roads; 2) avoiding work during critical breeding and rearing seasons for wildlife; 3) limiting the production of excess drilling fluids; and 4) avoiding discharges of drilling fluids into aquatic systems.

A residual cumulative effect on the loss of wetland function is expected. However, the residual cumulative effect is not expected to be significant because of the on- and off-site mitigation measures described in the Wetland Compensation Plan (**Appendix 5.3.7A**).

19.4.2.4.4 Significance of Potential Residual Cumulative Effects

The Project will contribute to additional loss of wetland extent and function in combination with the three past, present, and future activities (forestry, agricultural, and mineral exploration) identified in the RSA for this CEA. The significance of the Project's contribution to cumulative effects in the RSA was determined at the post-closure phase for this assessment as wetlands mitigation and compensation will occur prior to and concurrent with construction, and during operations and closure. Due to the minimal loss of wetland extent and functions associated with forestry, agricultural, and mineral exploration, the significance determination for residual cumulative effects is Not Significant (minor) as a result of Project implementation (**Table 19.4.2-8**) because of the mitigation and compensation measures for the Project. The level of confidence is moderate due to the risk associated with the wetland mitigation measures, which can be addressed through monitoring to ensure the success of the created wetlands on site.



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Table 19.4.2-8: Residual Cumulative Effects Assessment for Loss of Wetland Extent and Functions

Effect Attribute	Current / Future Cumulative Environmental Effect(s) without Project	Cumulative Environmental Effect(s) with Project
Context	Medium	Medium
Magnitude	Low	Low
Geographic extent	Regional	Regional
Duration	Long Term	Long Term
Reversibility	Yes	Yes
Frequency	Intermittent	Intermittent
Likelihood Determination	High	High
Level of confidence for Likelihood	High	High
Significance Determination	Not Significant (minor)	Not Significant (minor)
Level of confidence for Significance	High	Moderate

19.4.2.4.5 Limitations

Limitations are inherent with the production of an ecosystem map meant to represent the baseline condition that forms the foundation of the environmental assessment. Every attempt was made to produce a reliable and accurate ecosystem map following standard protocols and BMPs. The assumption is that sufficient information is available to assess the Project and to develop mitigation measures.

19.4.2.4.6 Conclusions

The Project will directly affect 309.3 ha (9.3%) of wetland ecosystems in the mine site during construction, operations, and closure. An additional 132.6 ha of wetland functions may be degraded, and 89.9 ha of wetlands may be hydrologically altered. The primary effect on the Wetlands VC will be the loss of wetland extent and functions, and the degradation of functions provided by remaining wetlands. Mitigation measures to address these impacts include avoidance, minimization, and compensation actions. After considering mitigation measures, the temporal loss of wetland functions remain as residual effects. The loss of wetland functions was rated as a Not Significant (moderate) effect as there will be a less than 1% reduction in wetland cover at post-closure within the mine site. During operations and closure the temporal loss of wetland functions between the time that impacts occur and the time new wetlands are created will be minimized through establishing off-site wetland compensation sites prior to or concurrently with the impacts. The cumulative effects of forestry, agriculture, mineral exploration, and the Project on the Wetlands VC were assessed for the RSA. Potential cumulative effects of the Project on wetland extent and functions are expected to be Not Significant (moderate) within the RSA as a result of mitigation measures.



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19.4.2.5 Physiography and Topography

As a result of the Project, changes at the landscape level will occur. The Project will have direct effects on slope gradients and topographic function of the landscape. The development of a compact Project footprint and the eventual reclamation of the site will reduce the overall effect of the Project on the Physiography and Topography VC. The original distribution of baseline topographic conditions will not be re-established; however, upon reclamation, a fully functional landscape will be developed to support the end land use objectives. Following all mitigation measures, residual effects, in the form of new topographic features and waterbodies, are expected to remain for the Physiography and Topography VC.

The residual effect of alteration of the baseline landscape for the Physiography and Topography VC will be carried forward into the CEA, as this effect has not been determined to be negligible. **Table 19.4.2-9** presents the rationale for carrying the effect forward into the CEA.

Table 19.4.2-9: Project-Related Residual Effects; Rationale for Carrying Forward into the CEA

Project Component	Project Phase	Residual Effect	Rationale	Carried Forward in Cumulative Effects Assessment
All	C, O, D/C	Alteration of baseline landscape	Due to the changes in the baseline landscape	Yes

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

19.4.2.5.1 Mitigation Measures

No additional mitigation measures are required to address the cumulative effects. Mitigation measures defined as part of the Project and presented above will mitigate the anticipated cumulative effects.

19.4.2.5.2 Potential Residual Cumulative Effects and their Significance

Alteration of baseline landscape will occur due to the Project, but reclamation activities will return the land to equivalent capability similar to baseline conditions and meet end land use objectives, with functionality restored.

A number of projects and human activities overlap with the RSA for physiography and topography. These activities include mining exploration and forestry logging, guide outfitters, active and pending range tenures, and recreational activities such as hunting and fishing. These activities have only a marginal potential to affect the physiography or topography in the RSA due to the creation of access roads; therefore, the potential for interaction with the residual effects of the Project is minimal. The residual effect of the alteration of the baseline landscape is considered Not Significant (Minor). The rating of Neutral is used as there may be both positive and negative effects to the area as a result of the alteration of the baseline landscape. **Table 19.4.2-10** presents the summary for the residual cumulative effect for the Physiography and Topography VC.



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Table 19.4.2-10: Residual Cumulative Effects Assessment on Physiography and Topography VC by Project Development Phase

Parameter	Current / Future Cumulative Environmental Effect(s) without Project	Cumulative Environmental Effects with Project	Project Phase						
Alteration of Baseline Landscape									
Effect attribute									
Context	Low	Low	PC						
Magnitude	Low	Medium	PC						
Geographic extent	Local	Local	PC						
Duration	Chronic	Chronic	PC						
Frequency	Continuous	Continuous	PC						
Reversibility	Yes	Yes	PC						
Likelihood Determination	High	High	PC						
Level of Confidence for Likelihood	High	High	PC						
Significance Determination	Not Significant (Minor)	Not Significant (Minor)	PC						
Level of Confidence for Significance	High	High	PC						

Note: PC = post-closure

19.4.2.5.3 **Limitations**

The effects assessment for the Physiography and Topography VC is based on the information presented within the current Project Description. Changes to the Project Description following the completion of this assessment may affect the results of the quantitative assessment of the Project effects on the Physiography and Topography VC. Slope gradients associated with certain Project components were assumed, based on the current Project Description and Project understanding. Results from the detailed design phase of the Project may affect the results of the assessment; however, it is believed the assumptions contained herein are suitable in the context of the overall assessment.

19.4.2.5.4 Conclusion

Direct effects are expected to occur on the Physiography and Topography VC throughout all phases of the Project. As a result of the Project, changes at the landscape level will occur. The Project will have direct effects on slope gradients and topographic function of the landscape. The development of a compact Project footprint and the eventual reclamation of the site will reduce the overall effect of the Project on the Physiography and Topography VC. The original distribution of baseline topographic conditions will not be re-established; however, upon reclamation, a fully functional landscape will be developed to support the end land use objectives. Following all mitigation measures, residual effects, in the form of new topographic features and waterbodies, are expected to remain for the Physiography and Topography VC. The anticipated significance of those residual effects is rated as *Not Significant* (Moderate).



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19.4.2.6 Ecosystem Composition

The residual effect of ecosystem loss, nitrogen deposition and spread of invasive plants for the Ecosystem Composition VC will be carried forward into the Cumulative Effects Assessment (CEA). **Table 19.4.2-11** presents the rationale for carrying the effect forward into the CEA.

19.4.2.6.1 Interactions between the Ecosystem Composition VC and Other Past, Present, or Future Projects or Activities

A number of projects and human activities contain spatial overlap with the proposed features of the Project. These include recreational activities, forestry activities, transportation and access, mining activity, trapping and guide outfitting, traditional land use, and other projects. Some of these can be quantified, including the Nulki Hills Wind Project, mining activity (quarries and prospecting), forestry cutblocks and woodlots, and forestry-related roads. The RSA is a total of 45,000 ha (including the LSA), of which 14,689 ha interacts with these other projects or activities (**Table 19.4.2-12** and **Table 19.4.2-13**).

Forestry-related and mining activities in the Project area will be removing and altering ecosystem composition including nitrogen deposition from vehicles and equipment. The primary means to mitigate the effects of forestry operations will be by continuing to follow forest harvest guidelines (including cut block and road design) to minimize erosion and maximize reforestation, and by implementing invasive plant control measures and monitoring systems. The primary means to mitigate the effects of mining activity will be to minimize the footprint and implement mitigation measures reducing the spread of invasive plants species. The mountain pine beetle infestation is widespread. Similar to forestry practices mitigation measures will maximize reforestation, encourage natural regeneration and implement invasive plant control measures. Stands with a low proportion of pine affected by MPB and not harvested remain as altered but functioning ecosystems on the landscape.



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Table 19.4.2-11: Project Related Residual Effects – Rationale for Carrying Forward into the CEA

		Representative Current and Historical Land Use Future Land Use							Reaso Fores e Pro							
Indicator	Project Phase	Potential Residual Effect	Recreational (trails, fishing and lodges)	Forestry (cut blocks and woodlots)	Aboriginal Traditional Use	Trapping and Guide Outfitting	Mining (active, current prospecting, quarries)	Recreational (sites, trails,	ry (cut bloc ots)	Aboriginal Traditional Use	Trapping and Guide Outfitting	Agriculture (Present)	Natural Disturbance (Fire and MPB)	Nulki Hills Wind Project	Agriculture (pending range tenures)	Carried Forward into CEA
Ecosystem	C, O, CL,	Ecosystem Loss	1	ı	Ì	1	ı	1	KI	Ī	ı	Ì	KI	ı	NI	yes
Distribution	PC	Nitrogen Deposition	NI	NI	NI	NI	ı	NI	NI	NI	NI	NI	NI	NI	NI	yes
		Spread of Invasive Plants	I	ı	NI	NI	ı	I	KI	NI	NI	KI	ı	I	KI	yes
Riparian	C, O, CL,	Ecosystem Loss	I	ı	I	I	ı	I	KI	ı	I	ı	KI	ı	NI	yes
	PC	Nitrogen Deposition	NI	NI	NI	NI	I	NI	NI	NI	NI	NI	NI	NI	NI	no
Old Growth Forest	C, O, CL, PC	Ecosystem Loss	I	I	NI	NI	I	I	KI	I	I	I	KI	I	NI	yes
Traditional Use Plant	C, O, CL,	Ecosystem Loss	I	I	NI	NI	ı	NI	KI	I	ı	I	KI	I	I	yes
Habitat	PC	Nitrogen Deposition	NI	NI	NI	NI	ı	NI	NI	NI	NI	NI	NI	NI	NI	no
		Spread of Invasive Plants	I	I	NI	NI	ı	I	KI	NI	NI	KI	I	I	KI	yes

Note: I = interaction, KI = key interaction, NI = no interaction; C = construction, O = operation, CL = closure, PC = post-closure



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Table 19.4.2-12: Spatial Overlap by Project / Activity

Project	Spatial Overlap with Terrestrial RSA	Temporal Overlap with Terrestrial RSA	Amount of Overlap (ha)
Nulki Hills Wind Project	Yes	Yes	1,854
Mining activity	Yes	Yes	272 ⁽¹⁾
Forestry (cutblocks and woodlots) past, present, and future	Yes	Yes	13,107
Forestry roads	Yes	Yes	1,102
Total			14,689 ⁽²⁾

Note: (1) Current prospecting = 178.19 ha, and quarries = 94.11 ha

(2) The total does not equal the sum of the Projects because of overlap

Table 19.4.2-13: Spatial Overlap by BGC Unit

BGC Unit	Spatial Overlap with Other Projects ⁽¹⁾ (ha)
SBSdk	4,268
SBSdw3	2,365
SBSmc2	984
SBSmc3	5,785
ESSFmv1	1,285
ESSFmv1p	2
BAFAun	0
Total Spatial Overlap	14,689

Note: (1) Projects includes the Nulki Hills Wind Project, mining activity, forestry, and forestry roads.

19.4.2.6.2 Significance of Potential Residual Cumulative Effects Qualitative Type of Description

Table 19.4.2-14 summarizes the residual cumulative effects on the ecosystem composition VC. The effect of ecosystem loss for the ecosystem distribution, riparian ecosystems, and traditional use plant indicators were combined and considered together for the assessment. In addition, the assessment considers all Project phases. The table shows the CEAs both with and without Project contribution. The context is medium in both, given that sensitive ecosystems and ecosystems at risk could be affected with or without the project. The magnitude of the residual cumulative effects without the Project is considered low where reclamation, reforestation, and mitigation measures are implemented. The effect of the MPB is being reduced by these various measures and will drop from infestation level down to low.

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Table 19.4.2-14: Residual Cumulative Effects Assessment on Ecosystem Composition

Parameter	Current / Future Cumulative Environmental Effect(s) without Project	Cumulative Environmental Effect(s) with Project		
Ecosystem Loss				
Effect Attribute				
Context	Medium	Medium		
Magnitude	Low	Medium		
Geographic Extent	Regional	Regional		
Duration	Long-term	Chronic		
Reversibility	Yes	Mine-related landforms (no) Natural landforms (yes)		
Frequency	Once	Once		
Likelihood determination	High	High		
Level of confidence for likelihood	High	High		
Significance Determination	Not Significant (Low)	Not Significant (Moderate)		
Level of Confidence for Significance	Moderate	Moderate		

Alternatively, with the Project, the magnitude is considered medium, due to some permanent loss of ecosystems. The widespread forestry activity in the Project area results in a regional effect in both cases. With reforestation, reclamation, and mitigation, the cumulative effects are considered reversible where sensitive ecosystems are avoided. Cumulative effects of the Project add permanent loss of ecosystems to the landscape, resulting in irreversible effects, a high likelihood, and a Not Significant (moderate) rating.

19.4.2.6.3 Limitations

Limitations are inherent with the production of an ecosystem map meant to represent the baseline condition that forms the foundation of the environmental assessment. Every attempt was made to produce a reliable and accurate ecosystem map following standard protocols and BMPs. The assumption is that sufficient information is available to assess the Project and to develop mitigation measures.

19.4.2.6.4 Conclusion

The Project will affect ecosystem distribution, riparian ecosystems, old-growth forests, and traditional plant use habitat during the Project case. The primary effect on ecosystem composition indicators will be the permanent loss of baseline ecosystems. Further Project-related disturbance was predicted from dust emissions, nitrogen deposition, and the potential spread of invasive plants. Mitigation measures to address these effects include: implementing relevant management plans, including the LSVMRP, ISMP, Erosions and Sediment Control Plan, AQEMP, Water Quality and Liquid Discharges Management Plan, Aquatic Resources Management Plan, TAMP, Wildlife Management Plan, and RCP, and reclaiming disturbed lands following operations using native species.



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Following application of mitigation measures, ecosystem loss, nitrogen deposition and spread of invasive plants remained as residual effects. The key effect, ecosystem loss, will result in permanent loss of moderate magnitude due to a post-closure reduction of ecosystems (1,495 ha; 12%), riparian ecosystems (249 ha; 20%), old-growth forest (115 ha; 10%) and traditional use plant habitat (1,377 ha; 13%). The residual effect of ecosystem loss was rated Not Significant (moderate). The effect of nitrogen deposition was rated Not Significant (minor), because only a small area was expected to be affected, and the effects will likely diminish over time. The spread of invasive plants was determined to be Not Significant (minor) provided implementation of mitigation measures are implemented, the effect will remain of low magnitude.

Cumulative effects and mitigation measures of forestry activities, mining, and a wind project were assessed for the RSA. When considering the cumulative contribution of Project effects, permanent ecosystem composition loss was rated as Not Significant (moderate).

19.4.2.7 Plant Species and Ecosystems at Risk

The residual effect of ecosystems loss, nitrogen deposition and whitebark pine regeneration for the Plant Species and Ecosystems at Risk VC will be carried forward into the Cumulative Effects Assessment (CEA). A cumulative effect occurs if a Not Significant (minor) or Not Significant (moderate) residual effect for the Project occurs. **Table 19.4.2-15** provides the rationale for carrying the effect forward into the CEA.



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Table 19.4.2-15: Summary of the Significance, Rationale, and Cumulative Effect of Historical, Current, and Future Land Use Effects

		ŀ	Historical Land Use				Representative Current and Future Land Use					Reasonably Foreseeable Projects				
Indicator	Project Phase	Potential Residual Effect	Recreational (trails, fishing and lodges)	Forestry (cut blocks and woodlots)	Aboriginal traditional use	Trapping and guide outfitting	Mining (activities, current prospecting, quarries)	Recreational (sites, trails, fishing and lodges)	Forestry (cut blocks and woodlots)	Aboriginal traditional use	Trapping and guide outfitting	Agriculture (Present)	Natural disturbance (Fire and MPB)	Nulki Hills Wind Project	Agriculture (pending range tenures)	Carried Forward into CEA
Whitebark pine	C, O, D/C, PC	Ecosystem loss	1	I	I	ı	I	I	I	I	I	ı	KI	NI	NI	yes
		Nitrogen deposition	NI	NI	NI	NI	I	NI	NI	NI	NI	NI	NI	NI	NI	yes
		Whitebark pine regeneration	NI	NI	NI	NI	I	NI	NI	NI	NI	NI	KI	NI	NI	yes
Potential plant species at risk habitat	C, O, D/C, PC	Ecosystem loss	NI	I	I	NI	I	NI	KI	I	I	I	KI	NI	NI	yes
		Nitrogen deposition	NI	NI	NI	NI	I	NI	NI	NI	NI	NI	NI	NI	NI	yes



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19.4.2.7.1 Interactions between Plant Species and Ecosystems at Risk VC and other Past, Present, or Future Project/Activities

A number of projects and human activities contain spatial overlap with the proposed features of the Project. These include recreational activities, forestry activities, transportation and access, mining activity, trapping and guide outfitting, traditional land use, and other projects. Natural disturbance such as wildfires and MPB interact with the Project. MPB was observed to be widespread across the RSA. Attack severity and status are discussed in the Non-traditional Land and Resource Use (Section 7.2.6 of the Application).

Some of these activities can be quantified, and include the Nulki Hills Wind Project, mining activity (quarries and prospecting), and past, present and future forestry activity. The maximum interaction occurs with potential plant species at risk habitat, roughly 8,080 ha of overlap between past, present, and foreseeable future with potential plant species-at-risk habitat (**Table 19.4.2-16**). There is minimal (<1 ha) overlap between whitebark pine and other projects and activities, but whitebark pine is surrounded by and overlaps with 59 ha (6%) of MPB attack severity rating of Severe (greater than 31% of VRI stand affected). The current infection rate of whitepine blister rust is at 32% of the total whitebark pine distribution.

Table 19.4.2-16: Spatial Overlap by Project/Activity: Potential Plant Species-at-Risk Habitat

Project	Spatial Overlap with Terrestrial RSA	Temporal Overlap with Terrestrial RSA	Amount of Overlap (ha)
Nulki Hills wind project	Yes	Yes	876
Mining activity*	Yes	Yes	136
Forestry	Yes	Yes	7,068
Total			8,080

19.4.2.7.2 Mitigation Measures and Potential Residual Cumulative Effects

Forestry-related and mining activities in the Project area will be removing and altering plant species and ecosystems at risk VC including nitrogen deposition from vehicles and equipment. The primary means to mitigate the effects of forestry operations will be by continuing to follow forest harvest guidelines (including cut block and road design) to minimize erosion and maximize reforestation, and by implementing invasive plant control measures and monitoring systems. An element of uncertainty persists however in re-establishing plant species at risk because some sites may experience higher success than others depending on site-specific conditions.

The primary means to mitigate the effects of mining activity will be to minimize the footprint and implement mitigation measures reducing the spread of invasive plants species. The mountain pine beetle infestation is widespread. Similar to forestry practices mitigation measures will maximize reforestation, encourage natural regeneration and implement invasive plant control measures. Stands with a low proportion of pine affected by MPB and not harvested remain as altered but functioning ecosystems on the landscape. Whitepine blister rust mitigation will involve a multi-



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step/multi-agency process whereby a rust screening program is established to identify and plant rust resistant whitebark pine trees.

19.4.2.7.3 Significance of Potential Residual Cumulative Effects

Table 19.4.2-17 summarizes the residual cumulative effects on the Plant Species and Ecosystems at Risk VC. The effects of ecosystem loss for whitebark pine and potential plant species at risk habitat were combined and considered together for the assessment. In addition, the assessment considers all Project phases. The table shows the CEAs both with and without the Project contribution.

Table 19.4.2-17: Significance of Potential Residual Cumulative Effects on Plant Species and Ecosystems at Risk

Parameter	Current/Future Cumulative Environmental Effect without Project	Cumulative Environmental Effect with Project	
Ecosystem Loss			
Effect Attribute			
Context	high	high	
Magnitude	high	high	
Geographic extent	regional	regional	
Duration	chronic	chronic	
Reversibility	yes	natural landforms –yes mine-related - no	
Frequency	continuous	continuous	
Likelihood Determination	moderate	moderate	
Level of Confidence for Likelihood	High	High	
Significance Determination	Not Significant (moderate)	Not Significant (moderate)	
Level of Confidence for Significance	low	low	

Note: refer to Section 4.3.6 for assessment criteria

The ecological context is high because the Project may result in long-term to permanent effects on a SARA-listed species. Given the extent of MPB attack and white pine blister rust, the magnitude is considered high. Whitebark pine is affected province-wide hence the regional rating. The duration is over many years and chronic in both scenarios. The effects are likely to be reversible with reclamation, mitigation and reforestation for potential plant species at risk habitat but less likely for whitebark pine. Therefore, the level of confidence is low.

With the Project added, the magnitude, geographic extent, duration, and frequency remain the same. The Project adds irreversible ecosystem loss as a cumulative effect. The effects are likely to be reversible on natural landform types but not reversible on mine-related landform types. The widespread forestry activity in the Project area results in a regional effect. With the proposed mitigation for whitebark pine, rust-resistant trees will be re-established and monitored. For this



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reason, the significance ranking is Not Significant (moderate), but with a low confidence because of the level of uncertainty related to whitebark pine mitigation.

19.4.2.7.4 Limitations

Limitations are inherent with the production of a whitebark pine distribution map and an ecosystem map meant to represent the baseline condition, and which forms the foundation of the environmental assessment. Every attempt was made to produce as reliable and accurate a map product as possible, following standard protocols and best management practices.

19.4.2.7.5 Conclusion

The primary effect of the Project to the plant species and ecosystem at risk VC will be the loss of baseline ecosystems, dust, N deposition, and the potential spread of invasive plant species. For whitebark pine Project effects on whitebark pine regeneration is an additional influence. Mitigation measures to address these effects include optimization of the Project footprint, which occurred during the design phase, and implementing relevant management plans, including the 5 Year Whitebark Pine Management Plan, Air Quality and Emissions Management Plan, Transportation and Access Management Plan, Erosions and Sediment Control Plan, Landscape, Soil, and Vegetation Management and Restoration Plan, ISMP, and Wildlife Management Plan.

To further mitigate the effects of whitebark pine loss, mitigation will include a range of strategies including avoiding loss through project design, replanting, progressive reclamation and supporting research. Further discussion with regulatory agencies is anticipated to refine the research components to ensure the maximum benefit is derived from the work. Commitments include: increasing awareness, population inventory, rust screening, cone collection, reclamation trials, off-site transplanting and stand enhancement. Monitoring will be on-going through the life of the mine.

Ecosystem loss of whitebark pine and potential plant species-at-risk habitat was ranked as Not Significant (moderate). The effect of N deposition was ranked Not Significant (minor) as only a small area was expected to be impacted and the effect to species and ecosystems at risk likely to diminish over time. The effect of whitebark pine regeneration was ranked as Not Significant (moderate) because successful reclamation will likely foster Clark's nutcracker populations

Cumulative effects and mitigation measures of forestry activities, mining, and a wind project were assessed for the RSA. Mountain pine beetle and white pine blister rust affect whitebark pine populations province-wide, and therefore the magnitude with or without the Project is high. When considering the cumulative contribution of project effects, the magnitude, geographic extent, duration, and frequency remain the same. The Project adds irreversible ecosystem loss as a cumulative effect. The effects are likely to be reversible on natural landform types but not reversible on mine-related landform types; therefore, the effects were ranked Not Significant (moderate) for Plant Species and Ecosystems at Risk VC.



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19.4.2.8 Waterbirds

A Cumulative Effects Assessment (CEA) for the Water Bird VC is necessary because the Project is expected to have a Not Significant (minor) residual adverse effect on water bird habitat loss **Table 19.4.2-18**. Residual effects on water bird habitat loss that could arise from other projects or activities in the region should be assessed to fully understand the context of the residual adverse effects on the water bird habitat loss by the Project. The spatial boundary for this assessment is the RSA. The temporal boundaries include historical, present, and certain and reasonably foreseeable projects within the RSA.

Table 19.4.2-18: Project-related Residual Effects; Rationale for Carrying Forward into the CEA

Project Component	Project Phase	Residual Effect	Rationale	Carried Forward to Cumulative Effects Assessment
Mine site, airstrip, transmission line, freshwater supply pipeline and access roads	Construction through to Post- Closure	Habitat Loss and Alteration	Change in baseline habitat conditions	Yes

For the CEA of habitat loss for water birds, the most relevant land uses in the RSA that could potentially interact include forestry, mining, and agriculture activities and are listed in the project inclusion list (PIL) (**Section 4** of the Application). **Table 19.4.2-19** presents identified interactions between past, present, and future projects and land uses in the RSA for the CEA.

Table 19.4.2-19: Interactions between Waterbird Habitat Loss and other Past, Present, and Future Projects/Activities

	Historical	Representative Current and storical Land Use Future Land Use				
Potential Residual Effect	Forestry (cut blocks and woodlots)	Agriculture (range tenures	Mining (active, current prospecting, quarries)	Forestry (cut blocks and woodlots)	Agriculture (active range tenures)	Carried Forward into CEA?
Loss of Waterbird Habitat	I	I	I	I	I	Yes

Note: I = interaction, KI = key interaction, NI = no interaction

As with wetland function, a residual cumulative effect on the loss of wetland function is expected for water bird habitat loss. However, the residual cumulative effect is not expected to be significant because of the on- and off-site mitigation measures described in the Conceptual Wetland



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Compensation Plan (**Appendix 5.3.7A** of the Application) and other environmental management plans.

19.4.2.8.1 Potential Residual Cumulative Effects and Mitigation Measures

The Project will contribute to additional temporal loss of water bird habitat in combination with the past, present, and future activities (e.g., forestry, agricultural, and mineral exploration) identified in the RSA.

Forestry-related activities in the RSA have the potential to temporarily alter wetland functions through habitat conversion, noise pollution, erosion and sedimentation, and invasive species introduction. Although forestry activities do not typically result in loss of water bird habitat due to recommended buffers, the temporary effects on wetlands from current and future forestry activities could result in the long-term alteration of water bird habitat. Habitat conversion results from removing the over story in multi-strata forested wetland habitats.

Suggested mitigation measures for forestry activities include: 1) following forest harvest guidelines, including cutblock and road design to minimize erosion and maximize reforestation; 2) maintaining buffers around wetlands and riparian areas; 3) applying sediment control to areas around wetlands and other waterbodies; 4) implementing invasive plant control measures and monitoring systems; 5) maintaining drainage pathways and wetland hydrology by installing appropriately sized culverts for stream and wetland crossings; 6) avoiding harvesting in wetland and riparian areas; and 7) replanting native vegetation to expedite succession. These mitigation activities are already included in the environmental management plans for the Project (Section 12.2.1 of the Application). Logging activities in the RSA have generated loss of habitat; however, application of BMPs (BC MFLNRO, 2014) will protect the key wetland and open water habitats needed by water bird species by minimizing disturbance, increasing success of reforestation, and minimizing the duration of disturbance.

Agricultural activities in the RSA have the potential to cause the loss and degradation of wetland functions. Conversion of natural habitat to agricultural habitat typically results in the loss of wildlife habitat and many species of water birds. Cattle grazing can alter wetland vegetation cover in emergent habitats, and potentially introduce invasive vegetation species. Trampling can compact wetland soils and cause erosion in riparian areas resulting in sedimentation of surface waters. Mechanical harvesting of wetland vegetation can cause rutting and soil displacement. Farms and other agricultural operations can result in reduced water quality in wetlands due to fertilizer and pesticide use. Agricultural activities do not typically result in the loss of water bird habitat but may result in temporary habitat alteration.

Suggested mitigation measures for agricultural activities include: 1) establishing cattle exclusion zones to limit grazing to uplands, thereby minimizing erosion and sedimentation to riparian vegetation and allowing increased opportunity of bird use of water habitats; 2) minimizing pesticide and fertilizer use around aquatic resources and before precipitation events to limit chemical runoff from entering wetlands; 3) establishing protected riparian areas prior to clearing; and 4) controlling invasive species.



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Mining activities (e.g., current prospecting, exploration) occur southeast and northwest of the mine site, and are likely to continue into the future. Mineral prospecting can result in degraded water bird habitat through noise pollution, vegetation removal, and invasive species introduction. Loss of wetland extent is possible due to temporary access road construction.

Suggested mitigation measures for mineral exploration and prospecting, which are typical permit conditions under the *Mines Act* (Government of BC, 1996b), include: 1) pre-planning to avoid wetlands and minimizing stream crossings for access roads; 2) avoiding work during critical breeding and rearing seasons for wildlife; 3) limiting the production of excess drilling fluids; and 4) avoiding discharges of drilling fluids into aquatic systems.

As stated in the Wetland VC (**Section 5.3.7** of the Application), the Proponent is committed to following mitigation measures provided in the guidance document Wetland Ways: Interim Guidelines for Wetland Protection and Conservation in British Columbia (Cox and Cullington, 2009) to minimize adverse effects on wetland functions. If forestry, agricultural, and mineral prospecting practitioners in the RSA follow this guidance, then potential degraded wetland functions (and resultant water bird habitat) resulting from these activities can be successfully mitigated through avoidance and minimization. A residual cumulative effect on the loss of wetland function is expected for water bird habitat loss. However, the residual cumulative effect is expected to be Not Significant.

19.4.2.8.2 Significance of Potential Residual Cumulative Effects

The significance of the Project's contribution to cumulative effects in the RSA was determined at the post-closure phase for this assessment as wetlands mitigation and compensation will occur prior to and concurrent with construction, and during operations and closure. Due to the minimal loss of wetlands associated with forestry, agricultural, and mineral exploration; the significance determination for residual cumulative effects is Not Significant (minor) (**Table 19.4.2-20**). This incorporates the on and offsite mitigation measures described in the Conceptual Wetland Compensation Plan; (**Appendix 5.3.7A** of the Application); and other environmental management plans for the Project, as well as the recommended mitigation measures outlined above for the other activities. The level of confidence is high due to the low risk associated with the wetland mitigation measures, which can be addressed through monitoring to ensure the success of the created wetlands on site.



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Table 19.4.2-20: Residual Cumulative Effects Assessment for Loss of Water Bird Habitat

Effect Attribute	Current/Future Cumulative Environmental Effect(s) without Project	Cumulative Environmental Effects with Project
Context	Medium	Medium
Magnitude	Low	Low
Geographic Extent	Regional	Regional
Duration	Long Term	Long Term
Reversibility	Reversible	Reversible
Frequency	Intermittent	Once
Likelihood Determination	High	Low
Level of Confidence of Likelihood		
Significance Determination	Not Significant (minor)	Not Significant (minor)
Level of Confidence of Significance	High	High

19.4.2.8.3 **Limitations**

The key limitation of this assessment is with surveys conducted in the Project area to quantify breeding and migratory water bird species presence: some species may not have been present during times when surveys were conducted, or may have been present in the Project area where surveys were not conducted. Regional abundance is not known beyond results from habitat suitability models and professional judgment.

19.4.2.8.4 **Conclusions**

The Project will directly affect wetland ecosystems in the mine site during construction, operations, and closure. The primary effect on water bird habitat will be the temporal loss of wetlands. The potential residual effects include habitat loss and degradation of a small amount of moderate to high value habitat for water birds. These effects will primarily be caused by the: construction of new portions of the road; widening along the existing FSR; airstrip, freshwater pipeline, and mine site development; and clearing for the transmission line. Mortality risk was considered Not Significant, primarily due to the limited extent and magnitude of Project activity that overlaps key water bird habitats. Mitigation measures to address these impacts include monitoring and compensation actions to achieve an objective of no loss of amount of wetlands area due to the Project. After considering mitigation measures, the temporal loss of water bird habitat remains a residual effect. The loss of wetland habitat was rated as a Not Significant (minor) effect as there will be a less than 1% reduction in wetlands cover at post-closure within the mine site.

The cumulative effects of forestry, agriculture, mineral exploration, and the Project on water bird habitat loss were assessed for the RSA. Potential cumulative effects of the Project on water bird habitat loss are predicted to be Not Significant (minor) within the RSA as a result of mitigation measures such as BMPs (BC MFLNRO, 2014).



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19.4.2.9 Forest and Grassland Birds

A Cumulative Effects Assessment (CEA) for the Forest and Grassland Birds VC is necessary because the Project is expected to have a Not Significant (minor) residual adverse effect on forest and grassland bird habitat loss, and a Not Significant (moderate) residual adverse effect for Clark's nutcracker. The spatial boundary for this assessment is the RSA. The temporal boundaries include historical, present, and certain and reasonably foreseeable projects within the RSA. Rationale for carrying forward into the CEA is shown below in **Table 19.4.2-21** and **Table 19.4.2-22**.

Table 19.4.2-21: Project Related Residual Effects; Rationale for Carrying forward into the CEA for Forest and Grassland Birds (not including Clark's Nutcracker)

Project Component	Project Phase	Residual Effect	Rationale	Carried Forward to Cumulative Effects Assessment
Mine site, airstrip, transmission line, freshwater supply pipeline and access roads	Construction through to Post- Closure	Habitat Loss and Alteration	Decreases from the baseline amount of moderate to high rated suitable habitat available to forest and grassland birds	Yes

Table 19.4.2-22: Project Related Residual Effects; Rationale for Carrying forward into the CEA for the Clark's Nutcracker

Project Component	Project Phase	Residual Effect	Rationale	Carried Forward to Cumulative Effects Assessment
Mine site, airstrip, transmission line, freshwater supply pipeline and access roads	Construction through to Post- Closure	Habitat Loss and Alteration	Decreases from the baseline amount of moderate to high rated suitable habitat available to the Clark's nutcracker	Yes

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For the CEA, the most relevant land uses in the RSA that could potentially interact include forestry, mining, and agriculture activities and are listed in the project inclusion list (PIL) (**Section 4** of the Application). Identified interactions between past, present, and future projects and land uses in the RSA for the CEA are presented in **Table 19.4.2-23** and **Table 19.4.2-24**.

Table 19.4.2-23: Interactions between Forest and Grassland Birds (not including Clark's Nutcracker) and other Past, Present, and Future Projects/Activities

		orical d Use	Represe Fut			
Potential Residual Effect	Forestry (cutblocks and	Agriculture (range tenures	Mining (active, current prospecting,	Forestry (cutblocks and woodlots)	Agriculture (active range tenures)	Carried Forward into CEA?
Loss of Forest and Grassland Bird Habitat	ı	ı	I	I	ı	Yes

Note: I = interaction, KI = key interaction, NI = no interaction

Table 19.4.2-24: Interactions between Clark's Nutcracker and other Past, Present, and Future Projects/Activities

		orical d Use	Represe Fu			
Potential Residual Effect	Forestry (cutblocks and	Agriculture (range tenures)	Mining (active, current prospecting,	Forestry (cutblocks and woodlots)	Agriculture (active range tenures)	Carried Forward into CEA?
Loss of Clark's Nutcracker Habitat	I	I	I	I	I	Yes

Note: I = interaction, KI = key interaction, NI = no interaction

Forestry-related activities in the RSA have the potential to temporarily alter and degrade forest and grassland bird habitat through habitat conversion, erosion and sedimentation, and invasive species introduction. Forestry activities do not typically result in permanent loss of forest and grassland bird habitat and the effects on habitat loss are considered temporary for most species and expected to return to baseline conditions after reclamation for all species.

Forestry-related activities in the Project area will comprise degrading and removing some moderate-value habitat of Clark's nutcracker. The primary means to mitigate the impacts of forestry operations will include following forest harvest guidelines, including cutblock and road design; minimizing erosion and maximizing reforestation; and implementing invasive plant control measures and monitoring systems and other currently implemented BMPs. Given the adherence to these practices, the loss of baseline ecosystem composition to forestry is expected to be reversible as long as whitebark pine is replanted in these harvested areas.



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Agricultural activities in the RSA have the potential to cause the loss and degradation of forest and grassland bird habitat. Conversion of natural habitat to agricultural habitat typically results in the loss of habitat for forest birds and many species of grassland birds. Cattle grazing can alter forest and grassland bird habitat in emergent habitats, and potentially introduce invasive vegetation species. Trampling can compact soils and cause erosion in riparian areas resulting in sedimentation of surface waters. Mechanical harvesting of wetland vegetation can cause rutting and soil displacement. Farms and other agricultural operations can result in reduced water quality in forest and grassland bird habitat through fertilizer and pesticide use. Agricultural activities in the RSA are not expected to cause the loss or degradation of Clark's nutcracker habitat, as agricultural activities are present only at low elevations where whitebark pine is not found.

Mining activities (e.g., current prospecting, exploration) occur southeast and northwest of the mine site, and are likely to continue into the future. Mineral prospecting can result in degraded forest and grassland bird habitat through vegetation removal.

The known mining activity (i.e., current prospecting) is or will occur in the area to the west-northwest and southeast of the mine site. No known whitebark pine ecosystems are located in these areas therefore future mining activity is unlikely to overlap spatially with habitat Clark's nutcracker.

The interactions between residual effects on Clark's nutcracker related to the Project and past, present, or foreseeable projects and ecological effects are identified within the Project CEA and summarized in **Table 19.4.2-25**. The interactions include forestry activities, transportation and access activities, mining activities, and guide outfitting, traditional land use, recreational activities, and other projects, as well as the effects of disease, insects, and fire on whitebark pine habitat. The residual effect due to chronic temporal loss of baseline whitebark pine ecosystems as a result of the Project is only expected to occur to Clark's nutcrackers at the mine site.

Table 19.4.2-26 and **Table 19.4.2-27** summarize the residual effect and the extent and duration of the historical, current, and future land use effects.



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Table 19.4.2-25: Project Related Residual Effects – Rationale for Carrying Forward into the CEA

			Historical Land Use			Representative Current and Future Land Use and Ecological Effects						Reasonably Foreseeable Projects				
Indicator	Project Phase	Residual Effect	Recreational (trails, fishing and lodges)	Forestry (cutblocks and woodlots)	Aboriginal Traditional Use	Guide outfitting	Mining (activities, current prospecting, quarries)	nal Is, f	Forestry (cutblocks and woodlots)	Aboriginal Traditional Use	Guide outfitting	Agriculture (Present)	Natural Disturbance (Fire and MPB and Blister Rust)	Nulki Hills Wind Project	Agriculture (pending range tenures)	Carried Forward into CEA
Clark's nutcracker	C, O, CL, PC	Ecosystem Loss	NI	ı	NI	NI	ı	I	ı	I	I	I	KI	NI	NI	Yes

Note: I = interaction, KI = key interaction, NI = no interaction; C = Construction, O = Operations, CL = Closure, PC = Post-Closure



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Table 19.4.2-26: Assessment of Spatial and Temporal Overlap between the Project and Other Projects and Human and Ecological Actions with Ecosystem Composition

	Human or Natural Activity	Residual Environmental Effect	Extent	Duration	Rationale	Cumulative Effect (Contribution from Project or Overlap)
	Forestry	Change in baseline ecosystems	Regional	Chronic	Forestry companies operate within the RSA	Yes
Historical Land Use	Recreation	Disturbance	Regional	Chronic	Trails and other access routes in the RSA	No
	Guiding	Disturbance and mortality	Regional	Chronic	Hunters and trappers operate within the RSA	No
	Traditional use	Change in baseline ecosystems	Regional	Chronic	Aboriginal groups are present within the RSA	No
	Forestry activities	Change in baseline ecosystems following forestry	Regional	Chronic	Forestry companies will continue to pursue logging operations	Yes
Representative Current and	Traditional use	Change in baseline ecosystems	Regional	Chronic	A RCP for re-vegetation is in place	No
Future Land Use	Mining	Change in baseline ecosystems	Regional	Chronic	Mining projects will continue in the RSA	Yes
	Recreation	Disturbance	Regional	Chronic	Recreation will continue in the RSA	Yes



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Table 19.4.2-27: Assessment of Spatial and Temporal Overlap between the Project and Natural Actions with Ecosystem Composition for Clark's Nutcracker

Natural Action			Environmental Effect Extent Duration		Rationale	Cumulative Effect (Contribution from Project or Overlap)
White Pine Blister Rust	Change in baseline ecosystems	Regional	Chronic	Disease reduces the number of healthy trees that can produce cone crops	Yes	
Mountain Pine Beetle	Change in baseline ecosystems	Regional	Chronic	Infestation reduces the number of healthy trees that can produce cone crops	Yes (minor proportion of dead trees)	
Fire	Change in baseline ecosystems	Regional	Chronic	Timber harvesting companies will continue to pursue logging operations	No (no recent fires at Mount Davidson)	

19.4.2.9.1.1 Habitat Loss and Alteration

Activities quantified for habitat loss and degradation, include the Nulki Hills Wind Project, mining activity (quarries and prospecting), forestry cutblocks and woodlots, and forestry-related roads. The RSA is a total of 291,714 ha, of which 90,177 ha interacts these other activities and 160,462 ha interacts with natural disturbances (**Table 19.4.2-28**).

Table 19.4.2-28: Spatial Overlap of RSA by Source of Overlap

Project	Spatial Overlap with Terrestrial RSA	Temporal Overlap with Terrestrial RSA	Amount of Overlap (ha)
Nulki Hills Wind Project	Yes	Yes	2,896
Mining Activity	Yes	Yes	491 ⁽¹⁾
Forestry (cutblocks and woodlots) – past, present and future	Yes	Yes	82,161
Forest Service Roads	Yes	Yes	3,497
Fire	Yes	Yes	10,990
Mountain Pine Beetle ⁽³⁾	Yes	Yes	149,472
Total			249,507 ⁽²⁾

Note: (1) Current prospecting = 221 ha and Quarries = 202 ha;

(2) The total does not equal the sum of the Projects because of overlap;

(3) Mountain pine beetle infestations of ≥10%;

ha = hectare; RSA = Regional Study Area



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The activities included in **Table 19.4.2-28** were overlaid with the habitat rated as moderate and high for Clark's nutcracker to determine spatial overlap (**Table 19.4.2-29** and **Table 19.4.2-30**). About 12% was rated of moderate value and 2% of the high value habitat is overlapping with forestry and mining in addition to the potential Project effects. MPB has affected 58% of the moderate value habitat and 11% of the high value habitat for Clark's nutcracker; this calculation includes all pine species in the area.

Table 19.4.2-29: Spatial Overlap by Moderately Rated Clark's Nutcracker Habitat

Project	Spatial Overlap with Moderate Rated Habitat	Temporal Overlap with Moderate Rated Habitat	Amount of Overlap with RSA (ha)	Total Moderate Habitat in RSA (ha)	Amount of Overlap with Moderate Habitat (%)
Nulki Hills Wind Project	No	No	0	7,177	0
Mining Activity	Yes	Yes	94	7,177	1
Forestry (cutblocks and woodlots) – past, present, and future	Yes	Yes	808	7,177	11
Forest Service Roads	Yes	Yes	<1	7,177	<1
Fire	No	No	0	7,177	0
Mountain Pine Beetle	Yes	Yes	4,198	7,177	58
Total			5,100		

Note: ha = hectare; RSA = Regional Study Area

Table 19.4.2-30: Spatial Overlap by Highly Rated Clark's Nutcracker Habitat

Project	Spatial Overlap with High Rated Habitat	Temporal Overlap with High Rated Habitat	Amount of Overlap with RSA (ha)	Total High Habitat in RSA (ha)	Amount of Overlap with High Habitat (%)
Nulki Hills Wind Project	No	No	0	1,375	0
Mining Activity	Yes	Yes	28	1,375	2
Forestry (cutblocks and woodlots) - past, present, and future	No	No	0	1,375	0
Forest Service Roads	Yes	Yes	<1	1,375	<1
Fire	No	No	0	1,375	0
Mountain pine beetle	Yes	Yes	156	1,375	11
Total			184		

Note: ha = hectare; RSA = Regional Study Area

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19.4.2.9.2 Residual Cumulative Effects and Mitigation

A cumulative effects assessment for forest and grassland birds within the RSA was conducted because of the following conditions:

- Residual effects on forest and grassland bird habitat are considered Not Significant (minor) with moderate confidence;
- Red- and Blue-listed species are present within the Project area; and
- Loss of habitat will be chronic due to the length of time for the recovery of some habitats (e.g., mature forests including whitebark pine).

Typical mitigation measures for forestry activities include: 1) follow forest harvest guidelines, including cutblock and road design to minimize erosion and maximize reforestation; 2) maintain buffers around wetlands and riparian areas; 3) apply sediment control to areas around wetlands and other waterbodies; 4) to implement invasive plant control measures and monitoring systems, and 5) replanting native vegetation to expedite succession. These mitigation activities are already included in the environmental management plans for the Project (**Section 12.2.1**).

Typical mitigation measures for agricultural activities include: 1) establishing cattle exclusion zones to limit grazing to uplands, thereby minimizing erosion and sedimentation to riparian vegetation and allowing increased opportunity of bird use of water habitats; 2) minimizing pesticide and fertilizer use around aquatic resources and before precipitation events to limit chemical runoff from entering wetlands; 3) establishing protected riparian areas prior to clearing, and 4) controlling invasive species.

Typical mitigation measures for mineral exploration and prospecting, which are typical permit conditions under the *Mines Act* (Government of BC, 1996b), include: 1) pre-planning to avoid wetlands and minimizing stream crossings for access roads; 2) avoiding work during critical breeding and rearing seasons for wildlife; 3) limiting the production of excess drilling fluids, and 4) avoiding discharges of drilling fluids into aquatic systems.

19.4.2.9.3 Residual Cumulative Effects and Mitigation Measures for Clark's Nutcracker

A cumulative effects assessment for the VC within the RSA was conducted on Clark's nutcracker because of the following conditions:

- Residual effects on Clark's nutcracker are considered Significant (moderate) with low confidence because the Project interaction of temporal habitat loss is not well understood;
- The reclamation efforts to replace whitebark pine have not been proven to be effective at a large scale where natural actions such as fire, white pine blister rust, and MPB are present; and
- The nearest suitable habitat for Clark's nutcracker is 85 km away, suggesting that metapopulation exchange may be limited for the species.



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The declining health of whitebark pine within the LSA and RSA due to the spread of white pine blister rust will continue to degrade some of the moderate and high value habitat for Clark's nutcracker. A health assessment in 2013 determined that approximately 30% of the pine trees at Mount Davidson were infected with blister rust. Fire has not recently removed any moderate or high value Clark's nutcracker habitat; however, MPB has affected both moderate and high value Clark's nutcracker habitat.

19.4.2.9.4 Significance of Potential Residual Cumulative Effects

The Project will contribute to additional loss of forest and grassland bird habitat in combination with the past, present, and future activities (e.g., forestry, agricultural, and mineral exploration) identified in the RSA for this CEA. The significance of the Project's contribution to cumulative effects in the RSA was determined at the post-closure phase for this assessment as forests and other habitat loss will be mitigated through reclamation primarily during closure. Logging activities in the RSA have generated loss of habitat; however, application of BMPs (BC MFLNRO, 2014) will protect the key habitats needed by forest and grassland bird species by minimizing disturbance, increasing success of reforestation, and minimizing the duration of disturbance. Although Project effects and the effects of other activities in the RSA may be cumulative, no additional adverse residual effects on forest and grassland birds are anticipated due to the Project. Due to the loss of forest and grassland bird habitat associated with MPB, forestry, agricultural, and mineral exploration, the significance determination for residual cumulative effects is Not Significant (minor) as a result of Project implementation (Table 19.4.2-31) because of the mitigation and compensation measures for the Project and forestry management practices to reclaim forest cover. The level of confidence is moderate due to the uncertainty associated with the forest and grassland bird habitat mitigation measures.

Table 19.4.2-31: Residual Cumulative Effects Assessment for Loss of Forest and Grassland Bird (not including Clark's Nutcracker) Habitat

Effect Attribute	Current/Future Cumulative Environmental Effect(s) without Project	Cumulative Environmental Effect(s) with Project
Context	Medium	Medium
Magnitude	Low	Low
Geographic Extent	Regional	Local
Duration	Long-term	Long-term
Reversibility	Reversible	Reversible
Frequency	Intermittent	Once
Likelihood Determination	High	High
Level of Confidence for Likelihood	High	High
Significance Determination	Not Significant (minor)	Not Significant (minor)
Level of Confidence for Significance	High	Moderate



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Table 19.4.2-32 summarizes the residual cumulative effects on Clark's nutcracker. The assessment considers all Project phases. The tables include the CEAs both with and without Project contribution. The likelihood of no significant residual cumulative effects for Clark's nutcracker, both with and without the Project contribution, is considered low with chronic loss of the whitebark pine ecosystem. The mitigation measures (replanting whitebark pine and site restoration) proposed as part of the whitebark pine management plan, although successful in trials, have not proven effective on a large scale such as the Project (AMEC, 2013); therefore, low confidence is applied to the significance of the cumulative residual effect.

Table 19.4.2-32: Residual Cumulative Effects Assessment on Clark's Nutcracker

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

Note: PC = post-closure

19.4.2.9.5 Limitations

The key limitation of this assessment is the limited surveys conducted in the study areas to quantify the forest and grassland bird species presence over time, as some species may have cyclic population numbers. Regional abundance and habitat use are not known beyond habitat suitability models and professional judgment.

Baseline studies for Clark's nutcrackers were not sufficient to determine if there is a minimum area of suitable habitat threshold below which a viable population would not exist. As the presence of Clark's nutcrackers is also important to natural dispersal and regeneration of whitebark pine, any decline or loss of the local population could significantly affect the future viability of the listed whitebark pine ecosystem.

19.4.2.9.6 Conclusion

Forest and grassland birds will be adversely affected through loss and degradation of habitat during the life of the Project. The Project will directly affect 3% of the moderate suitable forest and



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grassland bird habitat in the RSA and 1% of high value habitat, not including Clark's nutcracker. The Project will directly affect 22% of the moderate and high value Clark's nutcracker habitat in the RSA before mitigation. Loss and degradation effects include effects from direct habitat loss due to Project construction, nitrogen and dust deposition on vegetation, and invasive species introduction and/or spread. There is a high probability that lost habitat will recover to average baseline conditions upon closure, except limited portions of the airstrip and access roads, but it will take many years for the establishment of mature forests including whitebark pine.

These effects will be primarily caused by the construction of new portions of the road, widening along the existing FSR, development of the airstrip, freshwater pipeline, and mine site, and clearing for the transmission line. Habitat degradation will occur from all Project components. The maximum extent of these effects is local for forest and grassland birds including Clark's nutcrackers, with the loss pertaining to the clearing limits and degradation within 50 m of those limits, although the majority of the degrading effects will occur within 10 m to 30 m from the road edges.

Mitigation and adaptive management plans will avoid and mitigate the majority of adverse effects. Where it is not possible to mitigate completely, the effects will be minimized to keep the magnitude of effects at a maximum of low, with the majority at a negligible to low level of impact. Mitigation measures include devising management plans (**Section 12** of the Application), implementing a reclamation and closure plan (**Section 2.6** of the Application), and following management plans to reduce noise and vibration, improve air quality, minimize invasive species, and avoid spills (**Section 12** of the Application), which may be disruptive to forest and grassland bird nesting.

Additional mitigation measures will help to minimize residual effects to an even greater degree. The most important mitigation measures for minimizing residual effects to forest and grassland birds will include:

- Maintain quantity and quality of wetlands and forest cover;
- Close and decommission access roads and trails after mine closure and reclamation are achieved; and
- Conduct habitat restoration of existing disturbed habitats affected by the current road and transmission line, including closure and decommissioning spur roads/trails.

The residual effect of habitat loss and degradation on forest and grassland birds is rated as Not Significant (minor); however, the residual effect on Clark's nutcracker is rated as Not Significant (moderate).

Cumulative effects of forestry and mining activities along with natural effects such as disease, insect infestation, and fire are rated as Not Significant (moderate) with low confidence on Clark's nutcracker with and without the Project contribution. The low confidence is due to more than 30% of the whitebark pine trees currently infected would be lost with white pine blister rust, which is an additional increase in loss of habitat to the Project, and the uncertainty of effectiveness of mitigation measures such as replanting of whitebark pine and maintenance of Clark's nutcrackers in the Project area. Although the mutualistic relationship between Clark's nutcracker and whitebark



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pine is understood, it is not currently known how the loss of this additional habitat associated with the Project for 80 years will affect generations of nutcrackers. There is a risk associated with these effects, with a potentially small breeding population (i.e., potentially only 1 to 3 pairs), and with the uncertainty of augmentation and other mitigation measures to maintain birds. The reclamation program for whitebark pine has not been proven effective at a large scale; however, adaptive management will be used in monitoring the success of the whitebark pine plantings in original habitat and new areas. It is expected that planted trees will take approximately 80 years to reach maturity and baseline levels of cone production.

19.4.2.10 Moose

A cumulative effects assessment (CEA) for the Moose VC is necessary because the Project is expected to have Not Significant (minor) residual adverse effects on moose mortality, movement patterns, and population dynamics. Residual effects on moose that could arise from other projects or activities in the region are assessed to understand the context of the residual adverse Project effects on moose. The spatial boundary for this assessment is the RSA. The temporal boundaries include historical, present, and certain and reasonably foreseeable projects within the RSA. Rationale for carrying forward into the CEA is shown in **Table 19.4.2-33**.

Table 19.4.2-33: Project Related Residual Effects; Rationale for Carrying Forward into the CEA

Project Component	Project Phase	Residual Effect	Rationale	Carried Forward to Cumulative Effects Assessment
Mine site, Airstrip, Transmission Line, Freshwater Supply Pipeline, and Access Roads	Construction through to Closure	Unavoidable mortality of moose	Changes in the mortality of moose	Yes
Mine Site, Airstrip, Transmission Line, Freshwater Supply Pipeline, and Access Roads	Construction through to Closure	Unavoidable changes in moose movement patterns	Changes in movement patterns	Yes
Mine Site, Airstrip, Transmission Line, Freshwater Supply Pipeline, and Access Roads	Construction through to Closure	Unavoidable indirect mortality of moose Change in predator-prey dynamics	Changes in predator-prey dynamics	Yes

The interactions between residual effects on moose related to the Project or past, present, and foreseeable projects and potential ecological effects are summarized below. Pre-existing habitat



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loss and fragmentation due to logging and road development have altered the low elevation habitat within the Project area. The MPB infestation has affected large areas of mature pine forest in the region, which has resulted in alteration of moose habitat, some of which has been harvested while remaining forests are in various stages of degeneration due to the MPB. Mineral exploration in the area has increased the number of access roads, which have caused increased habitat fragmentation and road access for predators and hunters. Hunting season in the Project area is managed by BC MFLNRO; however, the area is also used by recreationalists who may impact moose by disturbance and displacement. Moose baseline information was collected in the LSA and portions of the RSA that were altered by these past and present activities. The current activities in the Project area are expected continue during the foreseeable future. For assessing cumulative effects for mortality of moose CEA, the most relevant land uses in the RSA that could potentially interact include forestry, mining, and agriculture activities. **Table 19.4.2-34** presents identified interactions between past, present, and future projects and land uses in the RSA.

Table 19.4.2-34: Interactions between Moose Residual Effects and other Past, Present, and Future Projects/Activities

	Historical	Land Use	Repres Fu			
Residual Effect	Forestry (cut blocks and woodlots)	Agriculture (range tenures	Mining (active, current prospecting,	Forestry (cut blocks and woodlots)	Agriculture (active range tenures)	Carried Forward into CEA?
Mortality	I	I	I	I	I	Yes
Movement Patterns	I	I	I	I	I	Yes
Population Dynamics	I	I	I	ļ	I	Yes

Note: I = interaction, KI = key interaction, NI = no interaction

A Wildlife Management Plan has been developed for the Project to provide mitigation recommendations for all components and phases of the Project. Other management plans (e.g., Landscape, Soils and Vegetation Management and Restoration, Sediment and Erosion Control) also provide relevant recommendations for Project mitigation. The Proponent is committed to following mitigation measures provided in the management plans to minimize adverse Project effects.

19.4.2.10.1 Potential Residual Cumulative Effects and Mitigation Measures

Forestry-related activities in the RSA have the potential to increase traffic along forest service roads creating potential barriers to the location of foraging and shelter habitat, thereby potentially altering moose movement and distribution patterns. The creation of new linear corridors may result in increased predator access and hunting, and change wildlife population dynamics. Although forestry activities may result in these effects, suitable habitat loss is typically temporary for moose. As forests and other habitats regenerate, they begin to revert to their baseline conditions and the nature of the effects typically subsides.



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Suggested mitigation measures for forestry activities include those suggested by BC MFLNRO (2004) as BMPs: 1) maintaining drainage pathways and wetland hydrology by installing appropriately sized culverts for stream and wetland crossings; 2) avoiding harvesting in wetland and riparian areas; 3) replanting native vegetation to expedite succession; 4) installing road signs to alert drivers of speed limits and of wildlife sensitive areas; 5) including wildlife awareness training for drivers during regular safety and environmental meetings; 6) decommissioning roads when they are no longer in use; and 7) providing breaks in snow banks along the access road to allow wildlife to escape. Several of these mitigation activities are already included in the environmental management plans for the Project (Section 12.2.1). Logging activities in the RSA have generated loss of habitat; however, application of BMPs (BC MFLNRO, 2014) will protect the key habitat needed by moose.

Agricultural activities in the RSA have the potential to increase moose mortality, change movement patterns, and alter wildlife population dynamics. Cattle grazing can alter vegetation cover in emergent habitats, and potentially introduce invasive vegetation species. Trampling can compact wetland soils and cause erosion in riparian areas resulting in sedimentation of surface waters. Mechanical harvesting of vegetation can cause rutting and soil displacement. Similar to forestry activities, agricultural activities do not typically result in large changes to mortality risk, wildlife movements or wildlife population dynamics.

Suggested mitigation measures include those suggested by BC MFLNRO (2004) as BMPs for agricultural activities include: 1) establishing cattle exclusion zones to limit grazing to uplands, thereby minimizing erosion and sedimentation; 2) minimizing pesticide and fertilizer use around aquatic resources and before precipitation events to limit chemical runoff from entering watersheds; 3) establishing protected riparian areas prior to clearing; and 4) controlling invasive species.

Mining activities (e.g., current prospecting, exploration) occur southeast and northwest of the mine site, and are likely to continue into the future. Mineral prospecting can result in changes to moose habitat, increased predator and hunter access, and increased vehicle collision mortality. These factors may result in minor changes to mortality risk, movement patterns, and population dynamics.

Suggested mitigation measures for mineral exploration and prospecting, which are typical permit conditions under the *Mines Act* (Government of BC, 1996b), include: 1) pre-planning to avoid important wildlife areas (e.g., wetlands, salt licks); 2) minimizing stream crossings for access roads; 2) avoiding work during critical breeding and rearing seasons for wildlife; 3) limiting the production of excess drilling fluids; 4) avoiding discharges of drilling fluids into aquatic systems; 5) installing road signs to alert drivers of speed limits and of wildlife sensitive areas; 6) including wildlife awareness training for drivers during regular safety and environmental meetings; 7) decommissioning roads when they are no longer in use; and 8) providing breaks in snow banks along the access road to allow wildlife to escape.



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19.4.2.10.2 Significance of Potential Residual Cumulative Effects

The significance of the Project's contribution to cumulative effects in the RSA was determined at the post-closure phase for this assessment as forest and other habitat mitigation and compensation will occur primarily during closure.

The Project will contribute to increased moose mortality, and changes in moose movement patterns and population dynamics in combination with the past, present, and future activities (e.g., forestry, agricultural, and mineral exploration) identified in the RSA for this CEA. The significance of the Project's contribution to cumulative effects in the RSA was determined at the post-closure phase for this assessment as forests and other habitat mitigation and compensation will occur primarily during closure. Logging activities in the RSA have generated loss of habitat; however, application of BMPs (BC MFLNRO, 2014) will protect the key habitats needed by moose. Although Project effects and the effects of other activities in the RSA may be cumulative, no additional adverse residual effects on moose are anticipated due to the Project. Due to the minimal changes in mortality risk, movement patterns or population dynamics associated with forestry, agricultural, and mineral exploration, the significance determination for residual cumulative effects is Not Significant (minor) (Table 19.4.2-35). This assumes effective implementation of the mitigation and compensation measures (e.g., Wildlife Management Plan, Vegetation Management and Restoration Plan, and Sediment and Erosion Control Plan) for the Project, and that forestry, agricultural, and mineral prospecting practitioners in the RSA follow the mitigation measures discussed above. With this guidance, potential effects of increased mortality and changes in wildlife movement patterns and population dynamics resulting from these activities can be successfully mitigated through avoidance and minimization.



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Table 19.4.2-35: Residual Cumulative Effects Assessment on Moose Mortality, Movement Patterns, and Population Dynamics

Effect Attribute	Current/Future Cumulative Environmental Effect(s) without Project	Cumulative Environmental Effect with Project
Mortality Risk		
Context	Medium	Medium
Magnitude	Low	Low
Geographic Extent	Regional	Local
Duration	Chronic	Long-term
Reversibility	Yes	Yes
Frequency	Intermittent	Intermittent
Likelihood Determination	High	High
Level of Confidence for Likelihood	High	High
Significance Determination	Not Significant (minor)	Not Significant (minor)
Level of Confidence for Significance	Moderate	Moderate
Change in Movement Patterns		'
Context	Medium	Medium
Magnitude	Low	Low
Geographic Extent	Regional	Site Specific
Duration	Chronic	Long-term
Reversibility	Yes	Yes
Frequency	Intermittent	Intermittent
Likelihood Determination	High	High
Level of Confidence for Likelihood	High	High
Significance Determination	Not Significant (minor)	Not Significant (minor)
Level of Confidence for Significance	Moderate	High
Change in Population Dynamics		·
Context	Medium	Medium
Magnitude	Low	Low
Geographic Extent	Regional	Local
Duration	Chronic	Long-term
Reversibility	Yes	Yes
Frequency	Intermittent	Intermittent
Likelihood Determination	High	High
Level of Confidence for Likelihood	High	High
Significance Determination	Not Significant (minor)	Not Significant (minor)
Level of Confidence for Significance	Moderate	High

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19.4.2.10.3 Limitations

The key limitation of this assessment is the limited surveys conducted in the study areas to quantify moose presence over time across the Project area. Regional abundance is not known beyond results of habitat suitability models and professional judgment based on Provincial population data.

19.4.2.10.4 Conclusions

Moose populations will be adversely affected through loss and alteration of habitat, increased mortality, changes in movement patterns, and changes in population dynamics. Moose mortality, movement patterns, population dynamics, and habitat within the Project area will be negatively affected during the life of the Project, but are expected to return to average baseline conditions upon post-closure based on the application of mitigation and monitoring from the WLMP (Section 12.2.1.18.4.6 of the Application), RCP (Section 2.6 of the Application), and results of the vegetation environmental assessment (Section 5.4.10 of the Application).

The Project residual effects include increased mortality due to vehicle collisions, and increased access for legal and illegal hunting within the RSA. Mortality effects will occur throughout construction and operations phases. The maximum geographic extent of these effects is considered local and there is moderate confidence and high likelihood that the effects will occur and that they will not have a significant effect on moose populations, due to mitigation measures and reclamation of habitats to baseline conditions for moose.

The Project residual effects in movement patterns result from changes in habitat availability and sensory disturbance. Effects on movement patterns will occur from all Project components, and will initially occur during construction, and will continue throughout operations. The maximum extent of these effects is considered local and there is high confidence and high likelihood that the effects will occur and that they will not have a significant effect on moose populations, due to mitigation measures.

The Project residual effect of changes in wildlife population dynamics will result from changes in foraging habitat and increased access for predators changing predation rates within the RSA. Population dynamic effects will occur from all Project components, will initially occur during construction, and will continue throughout operations. The maximum geographic extent of these effects is considered local and there is high confidence and high likelihood that the effects will occur and that they will not have a significant effect on moose populations, due to mitigation measures.

19.4.2.11 Caribou

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

 Residual effects on caribou habitat and population dynamics are rated Not Significant (moderate or minor) based on the Project components and the interaction with caribou within the RSA;



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- Residual effects on caribou have valid links with the effects of other past, present, or future activities within the RSA. Logging activities have caused loss of habitat within the RSA and, combined with loss of habitat due to wildfire and MPB infestation, a substantial amount of suitable habitat has been or will be negatively affected for both caribou subpopulations. There is a valid link between the Project effects and the effects of other activities within the RSA and Tweedsmuir-Entiako subpopulation range. Although potential residual effects of the Project are low (1% to 4% of available spring and summer habitats before reclamation, during seasons when trace numbers of caribou were detected within the RSA), these effects would contribute to the Caribou Recovery Strategy threshold of 35% disturbance of Type I Matrix Habitat (Environment Canada, 2014). Appendix 5.4.11C of the Application includes a habitat supply analysis for the subpopulations and identifies predation, MPB, fire, forestry and other cumulative effects as critical factors to consider in developing effective action plans for recovery of caribou; and
- A primary consideration in the assessment of caribou populations is the density of linear development. Several existing features overlap the wildlife cumulative effects areas relative to the caribou subpopulation areas (Figure 19.4.2-3 to Figure 19.4.2-7).

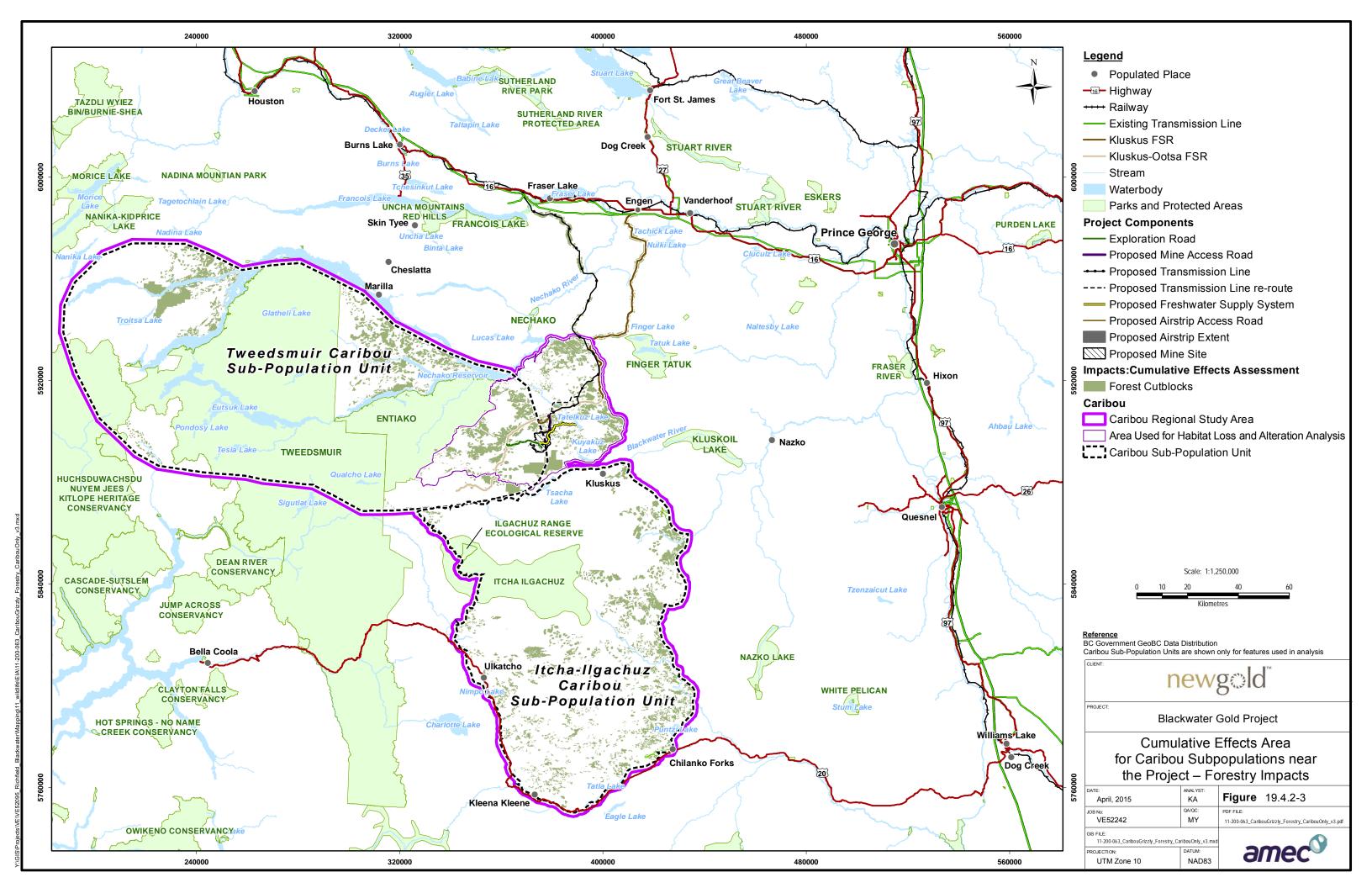
The residual Project effects of baseline habitat loss and changes to population dynamics are carried forward into the CEA, as these effects will overlap in space and time with the residual effects of other projects. **Table 19.4.2-36** presents the rationale for carrying the effect forward into the CEA. Cumulative effects are assessed for the habitat loss and alteration RSA (where suitability modelling allows detailed estimates of habitat quality loss) for the Tweedsmuir-Entiako caribou subpopulation that may be directly affected by the Project effects and for the Itcha-Ilgachuz subpopulation because of potential connectivity value through matrix habitat in the mine RSA. As a result, the CEA spatial boundary includes the habitat loss and alteration RSA for assessment of moderate to high value habitat directly affected by the Project (**Figure 19.4.2-5** and **Figure 19.4.2-6**). The caribou subpopulation boundaries are used for CEA as they are the units defined by Environment Canada (2014) for Caribou Recovery Strategy objectives.

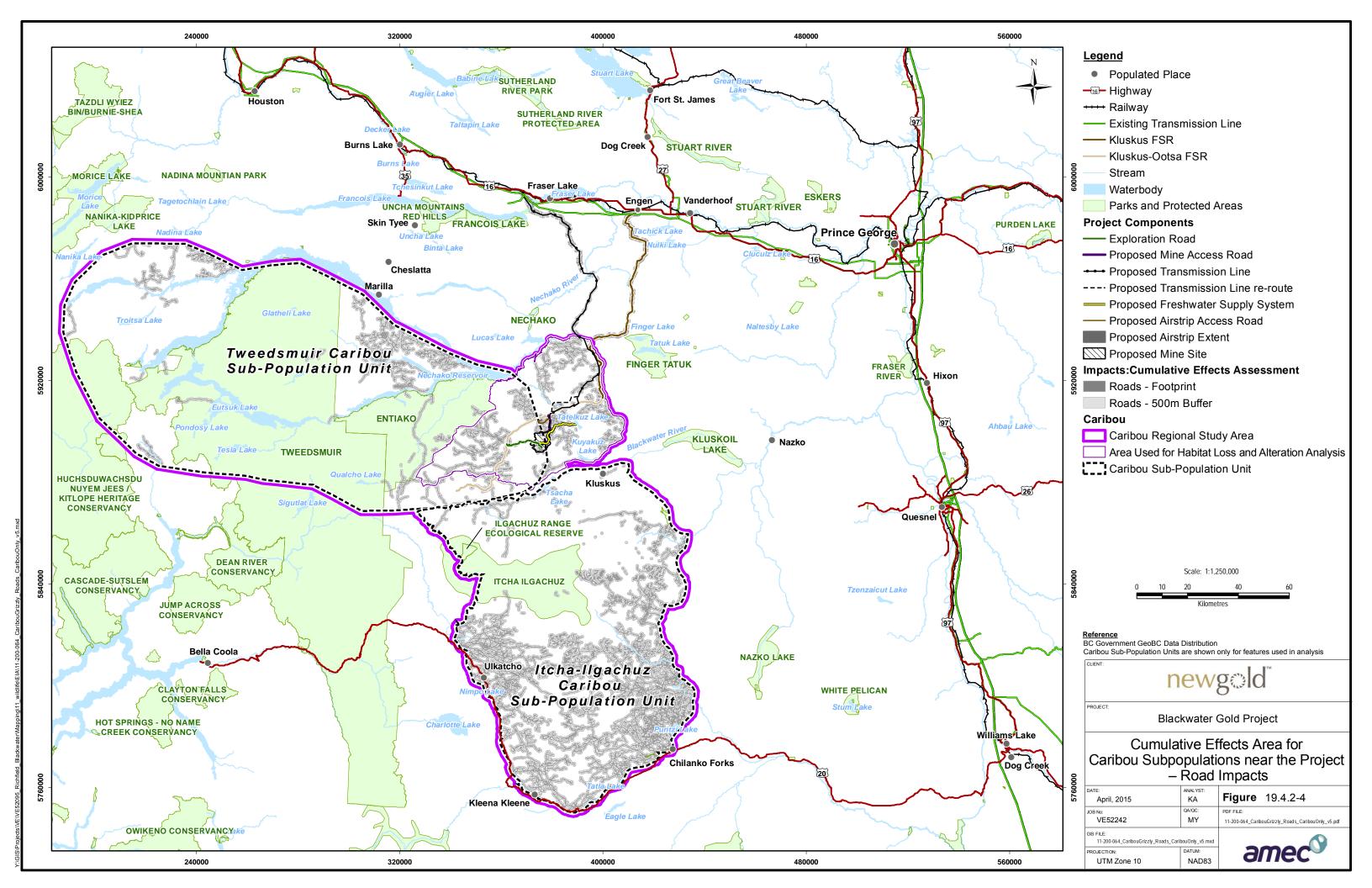
Table 19.4.2-36: Rationale for Carrying Residual Effects Forward for Caribou

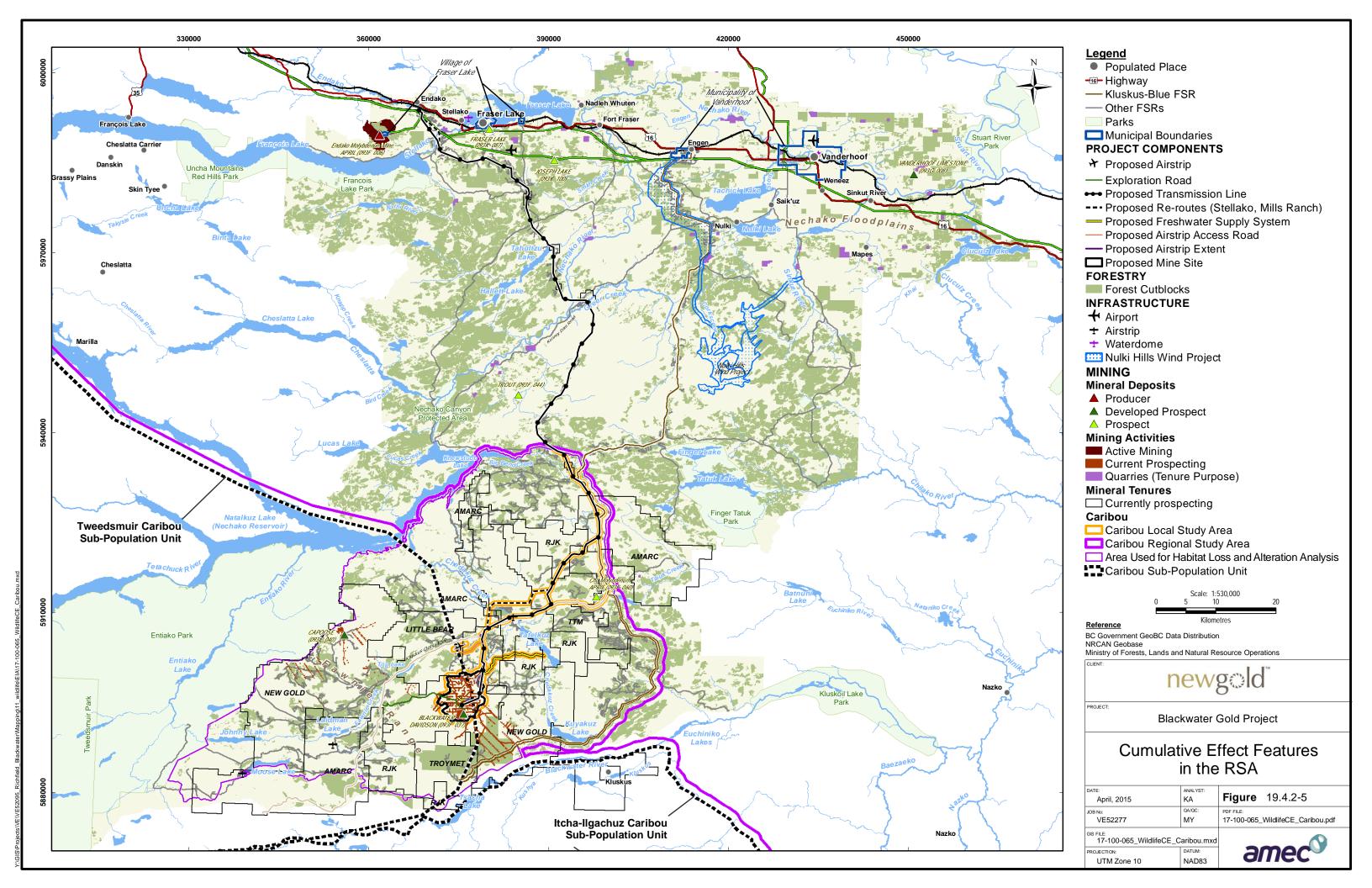
Project Component			Rationale	Carried Forward in Cumulative Effects Assessment
All	C, O, D/C	Unavoidable loss and alteration of habitat	Decreases from the baseline amount of moderate to high rated suitable habitat available to caribou	Yes
All	C, O, D/C	Unavoidable indirect mortality of caribou	Change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

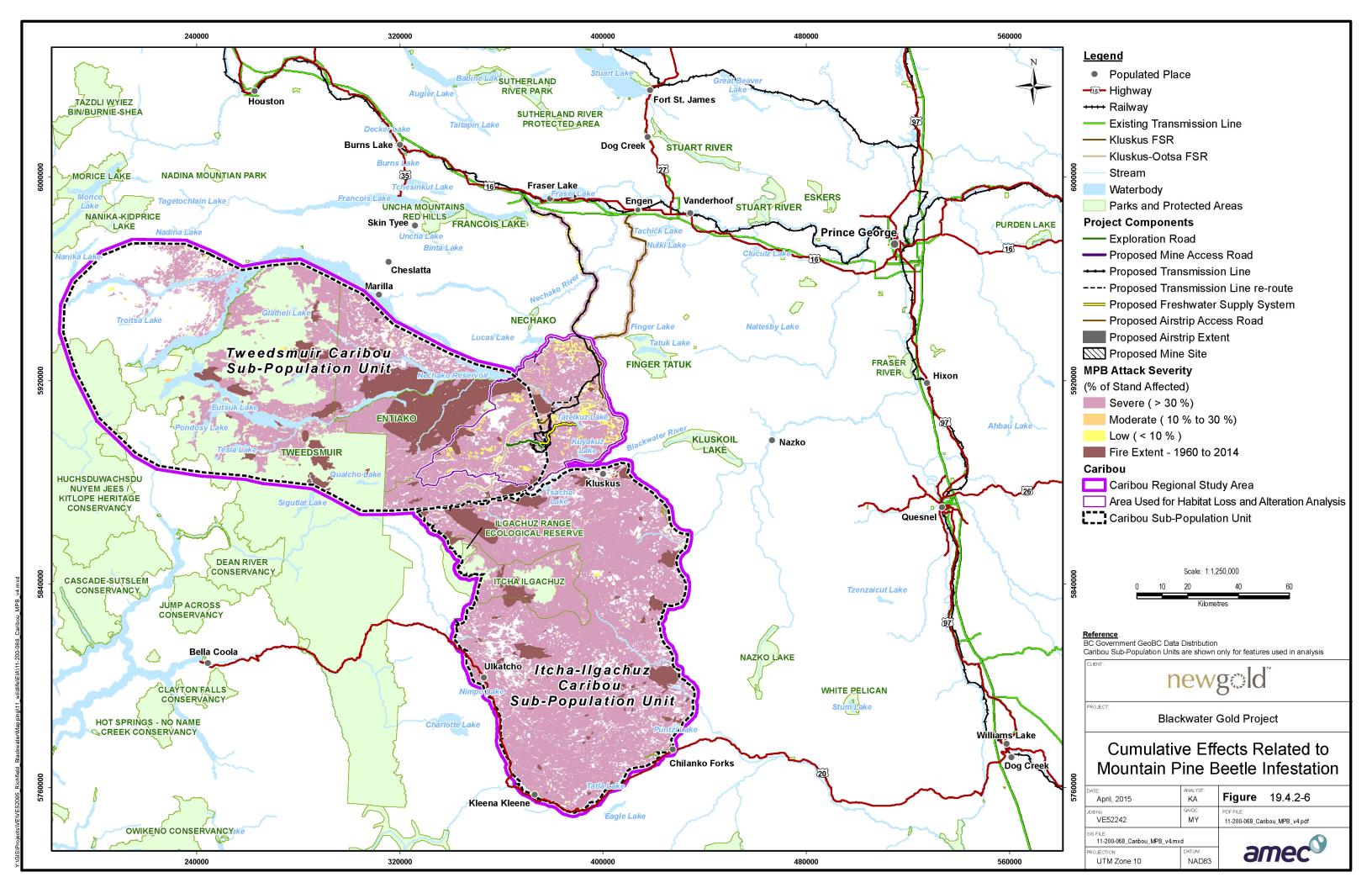
Note: C = construction; D/C = decommissioning/closure; O = operations

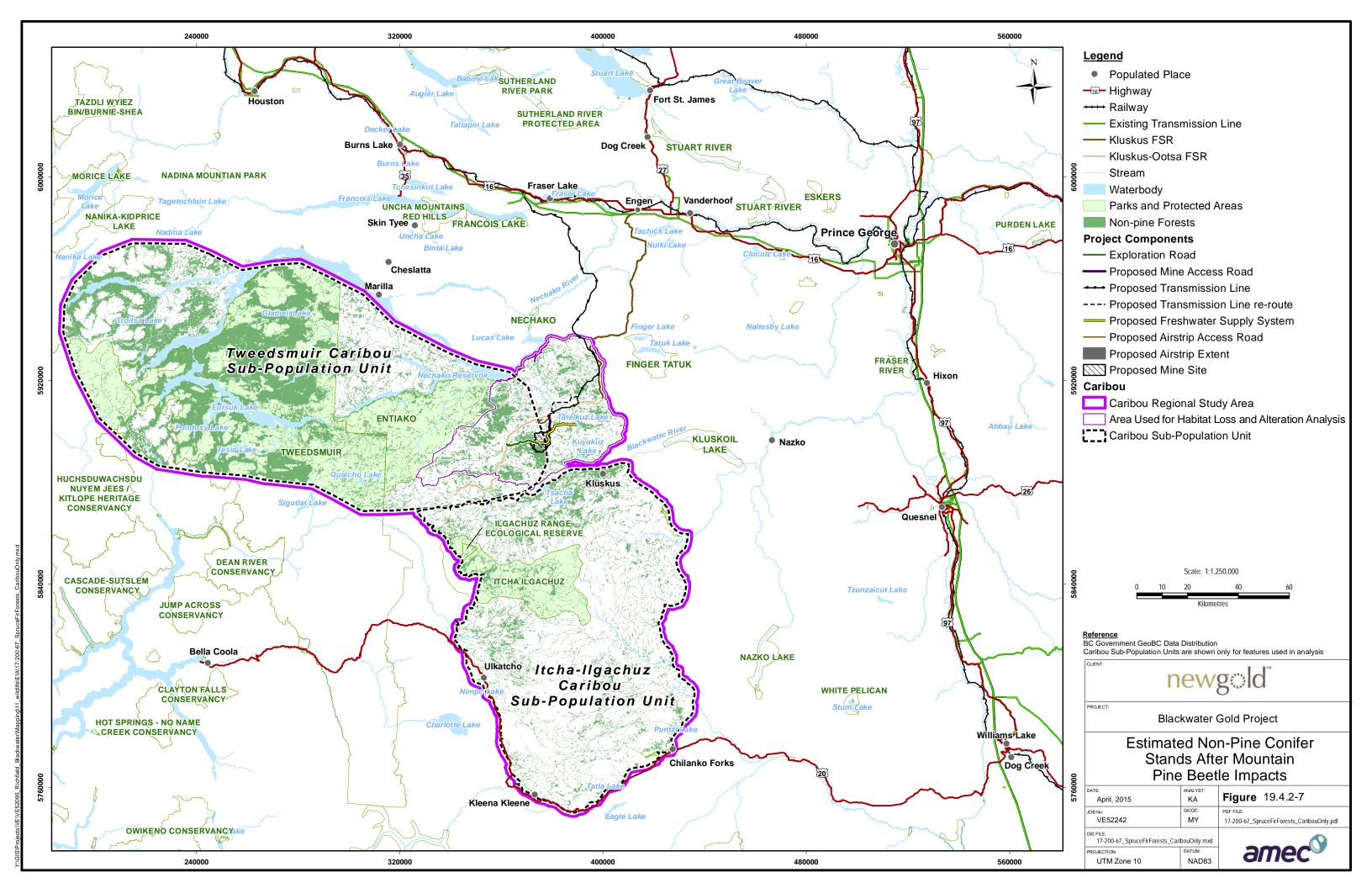












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19.4.2.11.1 Potential Cumulative Effects with other Past, Present, or Future Projects and Activities

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

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

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

Habitat fragmentation and linear density of roads likely contribute to baseline conditions of reduced caribou habitat suitability in the Project area as do changes in wildlife population dynamics that may result in increased predation rates on caribou (Hebblewhite et al., 2010; Apps et al. 2013;



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Steenweg, 2011; Whittington et al., 2011; Williamson-Ehlers, 2012; Williamson-Ehlers et al., 2013). The presence of significant areas of provincial parks and special RMZs reduces the potential for significant cumulative effects due to linear developments and industrial activity in the subpopulation areas.

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

Table 19.4.2-37 includes the effects of forestry activities, transportation and access, mining activities, trapping and guide outfitting, traditional land use, recreational activities, and other projects, as well as the effects of disease, MPB, and fire on caribou habitat.



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Table 19.4.2-37: Key and Moderate Interactions between Caribou Residual Effects and other Past, Present, and Future Projects/Activities

		His	torical	rical Land Use		Representative Current and Future Land Use and Ecological Effects					Reasonably Foreseeable Projects				
Project Phase	Potential Effect	Recreational (trails, fishing, lodges)	Forestry (cutblocks, woodlots)	Aboriginal Traditional Use	Trapping and Guide Outfitting	Mining (active, current prospecting, quarries)	Recreational (sites, trails, fishing, lodges)	Forestry (cutblocks, woodlots)	Aboriginal Traditional Use	Trapping and Guide Outfitting	Agriculture (present)	Natural Disturbance (fire, MPB, blister rust)	Nulki Hills Wind Project	Agriculture (pending range tenures)	Carried Forward into CEA?
C, O, CL, PC	Habitat Loss	Ī	KI	NI	NI	1	NI	KI	NI	NI	NI	KI	NI	NI	Yes
C, O, CL, PC	Changes to population dynamics, resulting in increased caribou predation by wolves	I	KI	I	I	I	NI	KI	I	NI	NI	KI	NI	NI	Yes

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



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Some of these anthropogenic disturbances are quantified and include mining activity (quarries and prospecting), forestry (cutblocks and woodlots), and forestry roads. The RSA comprises 291,714 ha, of which 90,177 ha interacts with anthropogenic disturbances, and 160,462 ha interacts with natural disturbances (**Table 19.4.2-38**).

Table 19.4.2-38: Spatial Overlap of Caribou RSA by Source of Habitat Loss

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

Note: ha = hectare; RSA = Regional Study Area

(1) The total does not equal the sum of the projects because of overlap

(2) Mountain Pine Beetle infestations of ≥ 10%

An overlap of the activities is included in **Table 19.4.2-38** with the habitat rated moderate to high for caribou (spring, summer/fall, and winter) (**Table 19.4.2-39**). Wildfires have impacted 19,337 ha (7%) of the RSA, 328 ha (3%) of the LSA and 146,608 ha (11%) of the Tweedsmuir subpopulation range and 66,248 ha (7%) of the Itcha Ilgachuz subpopulation range. MPB has impacted over 60% of moderate to high rated suitable caribou habitat in the RSA.

The named projects from the project inclusion list that represent present and future projects will not have interactions with the Project however the listed activities from the list will. Pre-existing habitat loss and fragmentation due to logging and road development has altered the higher suitability low elevation habitat within the Project area (see Table 19.4.2-40). The mountain pine beetle has infested large areas of mature pine forest in the region including the LSA and RSA, some of which was harvested while remaining forests are in various stages of regeneration. Logging and mineral exploration in the area increased the number of access roads. Caribou baseline information was collected in the study areas that have been altered by these past and present activities. Wildfire in 2014 has recently altered large portions of the MPB infested areas of the Tweedsmuir subpopulation and reduced overall suitable habitat. The future activities in the RSA are expected to include similar activities. With the increase of industrial and agricultural activities, loss of effective habitat may result in less suitable areas for caribou. Hebert (2014) has identified MPB related impacts to caribou as a key factor affecting between 53% and 60% of suitable habitat stands in map areas (Map Sheet 93F and 93C) where caribou occur, which is comparable to this cumulative effects analysis of impacts to moderate to high rated suitable caribou habitat in the RSA (>60% for different seasons).



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Table 19.4.2-39: Cumulative Effects – Spatial Overlap of Disturbance on Caribou Habitat by Rating Class in LSA and RSA

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

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

Effects are not measured relative to the LSA but are provided as a context for RSA assessment. Fires including those in 2014 have impacted a total of 146,608 ha within the Tweedsmuir caribou subpopulation range and 66,248 ha within the Itcha Ilgachuz caribou subpopulation range, including a total of 19,337 ha in the RSA.



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Table 19.4.2-40: Potential Adverse Effects Resulting from Past, Present and Future Projects and Activities

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

19.4.2.11.1.1 Residual Cumulative Effects and Mitigation Measures

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

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



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

Broad regional collaborative measures may include:

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

Overlaps of forestry, mining, roads, fire, and MPB infestation on moderate to high value caribou habitat are summarized in **Table 19.4.2-41** to **Table 19.4.2-43**.

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



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Table 19.4.2-41: Cumulative Effects – Spatial Overlap of Disturbance with Caribou Spring Season Habitat

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

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



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Table 19.4.2-42: Cumulative Effects – Spatial Overlap of Disturbance with Caribou Summer/Fall Season Habitat

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

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



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Table 19.4.2-43: Cumulative Effects – Spatial Overlap of Disturbance with Caribou Winter Season Habitat

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

 $\textbf{Note}: \quad \text{ha = hectare; LSA = Local Study Area; m = metre; RSA = Regional Study Area; \% = percentage}$



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Table 19.4.2-44: Assessment of Spatial and Temporal Overlap between the Project and Other Projects and Human and Ecological Actions with Ecosystem Composition

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



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Table 19.4.2-45: Assessment of Spatial and Temporal Overlap between the Project and Interactions with Ecosystem Composition for Caribou

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



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19.4.2.11.2 Assessment of Caribou Habitat Loss and Change in Population Dynamics

Based on the CEA of potential effects on caribou, MPB infestation and forestry activities are currently impacting the caribou subpopulation areas (**Table 19.4.2-46**). Project contribution to cumulative habitat loss is less than 1% of the CEA loss before reclamation.

The Tweedsmuir-Entiako subpopulation is currently considered at the minimum subpopulation size to be viable with an estimated population of 300 caribou; however, with the calf recruitment indicated as low (less than 1.0 per 100 cows), the subpopulation is considered to be in decline and to be at high risk (not self-sustaining) if the trend continues. The Itcha-Ilgachuz subpopulation is considered viable with an estimated population of 1,700 (Environment Canada, 2014). The declining health of pine forests within the LSA and RSA due to the outbreak and spread of MPB and forestry-related activities has degraded moderate and high value caribou habitat, and this alteration is expected to continue regardless of the Project. Forest fire has affected 2.5% (328 ha) of the LSA and 3.0% (8,098 ha) of the RSA and has the potential to affect caribou habitat in the future. The greatest impact is habitat alteration related to MPB (Figure 19.4.2-7) affecting 61% (7,994 ha) of the LSA and 53% (136,910 ha) of the RSA. With respect to the subpopulation areas, 39% (443,509 ha) of the Tweedsmuir-Entiako subpopulation and 69% (654,621 ha) of the Itcha-Ilgachuz subpopulation are effected by MPB infestation. The areas affected by MPB are expected to have reduced caribou habitat value, but some studies suggest that habitat value may be maintained depending on lichen persistence (Cichowski et al., 2008), so the percentage area affected by MPB does not equate to total habitat loss for caribou. Wildfire (including in 2014) has impacted 11% of the Tweedsmuir subpopulation range and 7% of the Itcha Ilgachuz subpopulation range (within the area affected by MPB).

Based on assessment of forestry stand data for remaining non-pine conifer forests in the subpopulation areas (**Figure 19.4.2-7**), the Tweedsmuir-Entiako subpopulation will have 29% (388,171 ha) of non-pine conifer forests and the Itcha-Ilgachuz subpopulation will have 8% (73,924 ha) of non-pine conifer forest remaining if all mature pine forests die after MPB infestation. These cumulative effects are expected to impact habitat supply for both caribou subpopulations, particularly in the Itcha-Ilgachuz subpopulation with 69% to 92% of the habitat area affected by MPB. The Tweedsmuir-Entiako subpopulation potentially has a 29% habitat loss but remains below the Environment Canada (2014) cumulative threshold of 35% and the Project contribution to the total is less than 1%. Additional habitat mitigation through enhanced reforestation of MPB areas will mitigate the habitat loss in the far future. Project effects make minor contributions to these cumulative effects which are created mainly by logging and MPB. Project mitigation measures will reduce the potential cumulative effects due to MPB and forestry in the Project LSA. Project mitigation includes research and reforestation of whitebark pine ecosystems as per the Whitebark Pine Management Plan.

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



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Hebert (2014) included the following assessment of habitat supply for areas affecting the 2 subpopulations in **Table 19.4.2-47**. Hebert (2014) has similar cumulative effects conclusions for the caribou subpopulations.

Table 19.4.2-46: Summary of Potential Cumulative Effects from Fire and Mountain Pine Beetle

Subpopulation		Loss of LSA Habitat	Loss of RSA Habitat	Loss of Herd Area
	Fire	2.5% (328 ha)	3.0% (8,098 ha)	N/A
Tweedsmuir- Entiako	MPB	61% (7,994 ha)	53% (136,910 ha)	39% (443,509 ha)
	Remaining non-pine conifer stands	-	-	29% (388,171 ha)
	Fire	-	-	N/A
Itcha-Ilgachuz	MPB	-	-	69% (654,621 ha)
	Remaining non-pine conifer stands	-	-	8% (73,924 ha)

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

Table 19.4.2-47: Habitat Supply Analysis (Hebert, 2014)

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



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19.4.2.11.2.1 Significance of Residual Cumulative Effects in the RSA

The residual cumulative effects on caribou are summarized in **Table 19.4.2-48**, shown with and without Project contribution. Residual cumulative effects without the Project are considered negative with permanent loss of habitat and impacts to population dynamics. Residual cumulative effects currently affects 29% of the RSA, including effects of the two greatest contributors—forestry and MPB. This level of disturbance is lower than the potential 35% threshold identified by Environment Canada (2014). However, due to the large area affected by MPB, there is a reasonable likelihood that future cumulative impacts to caribou habitat could increase beyond the 35% threshold even in the absence of project residual effects. Within the habitat loss and alteration RSA, the Project contribution to potential cumulative habitat loss of moderate to high value habitat is far less than 1% of this total, which is well below the 20% threshold for Project-related disturbance. The Environment Canada (2014) threshold of 35% disturbed area within the subpopulation critical and matrix habitat is currently not exceeded; therefore, the habitat loss and alteration in the CEA related to the project is considered Not Significant (moderate).

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

Table 19.4.2-48: Post-Closure Residual Cumulative Effects Assessment on Caribou

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



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19.4.2.11.3 Limitations

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

19.4.2.11.4 Conclusions

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

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

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

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

19.4.2.12 **Grizzly Bear**

A CEA for the grizzly bear VC is necessary because the Project is conservatively predicted to have a Not Significant (minor) residual adverse effect on grizzly bear habitat loss and Not Significant (minor) residual adverse effect on grizzly bear risk of mortality. Residual effects on grizzly bear have valid links with the effects of other past, present, or future activities within the RSA. Logging activities have caused loss of habitat within the RSA and, combined with loss of habitat due to wildfire and MPB infestation, a substantial amount of suitable habitat has been or will be negatively affected for grizzly bear populations. A primary consideration in the assessment of grizzly bear is the density of linear development. Several existing features overlap the wildlife cumulative effects



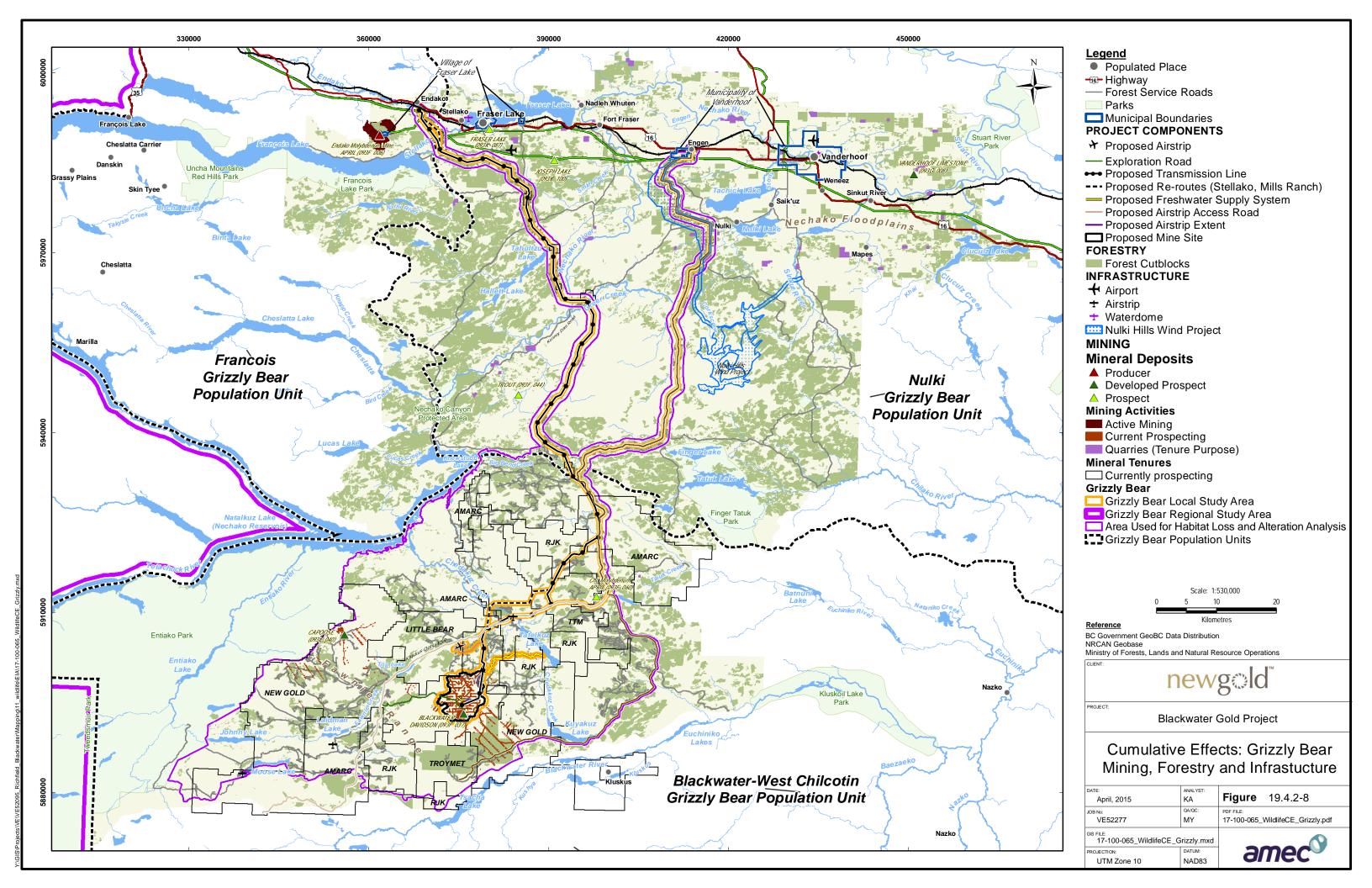
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areas relative to the GBPUs. Residual effects on grizzly bear habitat loss and risk of mortality that could arise from other projects or activities in the region are assessed to fully understand the context of the residual adverse effects on the grizzly bear habitat loss and risk of mortality by the Project. The spatial boundary for this assessment is the RSA. The temporal boundaries include historical, present, and certain and reasonably foreseeable projects within the RSA and GBPUs (**Figure 19.4.2-8**). Rationale for carrying forward into the CEA is shown in **Table 19.4.2-49**.

Table 19.4.2-49: Project Related Residual Effects; Rationale for Carrying forward into the CEA

Project Component	Project Phase	Residual Effect	Rationale	Carried Forward to Cumulative Effects Assessment
Mine site, airstrip, transmission line, freshwater supply pipeline and access roads	Construction through to Closure	Habitat Loss	Change in habitat availability from baseline conditions	Yes
Mine site, airstrip, transmission line, freshwater supply pipeline and access roads	Construction through to Closure	Mortality Risk	Change in mortality	Yes



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For the CEA of habitat loss for grizzly bear, the most relevant land uses in the RSA that could potentially interact include recreation, forestry, Aboriginal land use, hunting and guide outfitting, mining, and agriculture activities and are listed in the project inclusion list (PIL) (**Section 4** of the Application). Identified interactions between past, present, and future projects and land uses in the RSA for the CEA are presented in **Table 19.4.2-50**.

Recreation-related activities within the RSA will potentially degrade but not remove grizzly bear habitat through increased human use of these areas. Activities that may affect grizzly bear habitat include hunting, snowmobiling, off-road vehicle use, and camping. There is no hunting in the Project area; however, the area is used by recreationalists who may impact grizzly bears by disturbance, displacement, and defence of life and property kills of grizzly bear.

Hunting and guide outfitting may cause disturbance. Due to grizzly bear avoidance of areas of human activity, hunting and guiding may result in the temporary degradation of grizzly bear habitat; however, the duration of these effects is expected to be short-term and negligible.

Forestry-related activities in the GBPUs will potentially temporarily alter habitat availability through habitat conversion, noise pollution, erosion and sedimentation, invasive species introduction, and road avoidance (**Figure 19.4.2-9** and **Figure 19.4.2-11**). Forestry activities typically result in the removal of forested habitats. Wetland and riparian habitats are not usually removed; however, removal of forest surrounding these areas may cause degradation of these habitats.

The MPB infestation has affected large areas of mature pine forest in the region, which may result in a loss of grizzly bear habitat if areas are accessed and logged. Some MPB-killed pine forest has been harvested while remaining forests are in various stages of degeneration due to the MPB.

Natural disturbances, such as the MPB infestation, have contributed to the declining health of lodgepole pine forests within the GBPUs and increased access for logging. Further degradation of moderate and high value grizzly habitat may occur with a 58% loss of pine forest overlapping moderate to high value late summer / fall habitat and 63% loss of pine forest overlapping moderate to high value summer habitat in the RSA (**Figure 19.4.2-11**). Fire has affected 7.6% (22,230 ha) of the RSA, and is expected to affect grizzly habitat in the future. Fire and MPB both contribute to an increase in forest canopy openings that result in an increase in shrubs and forbs until forests regenerate, creating suitable feeding habitat for grizzly bears. The main concern for grizzly bear habitat is the maintenance of security and thermal cover, typically mature forest, near good feeding areas.



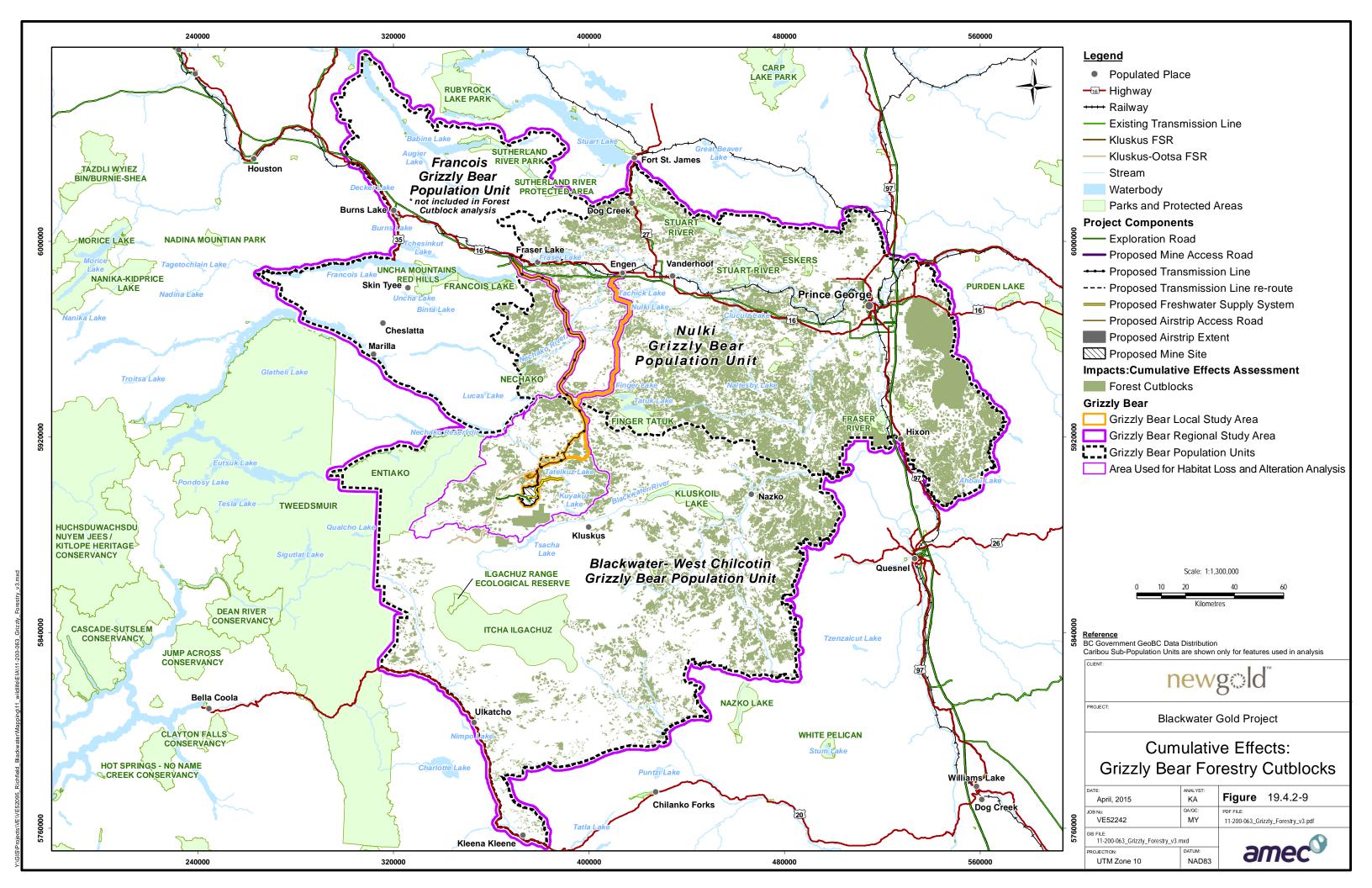
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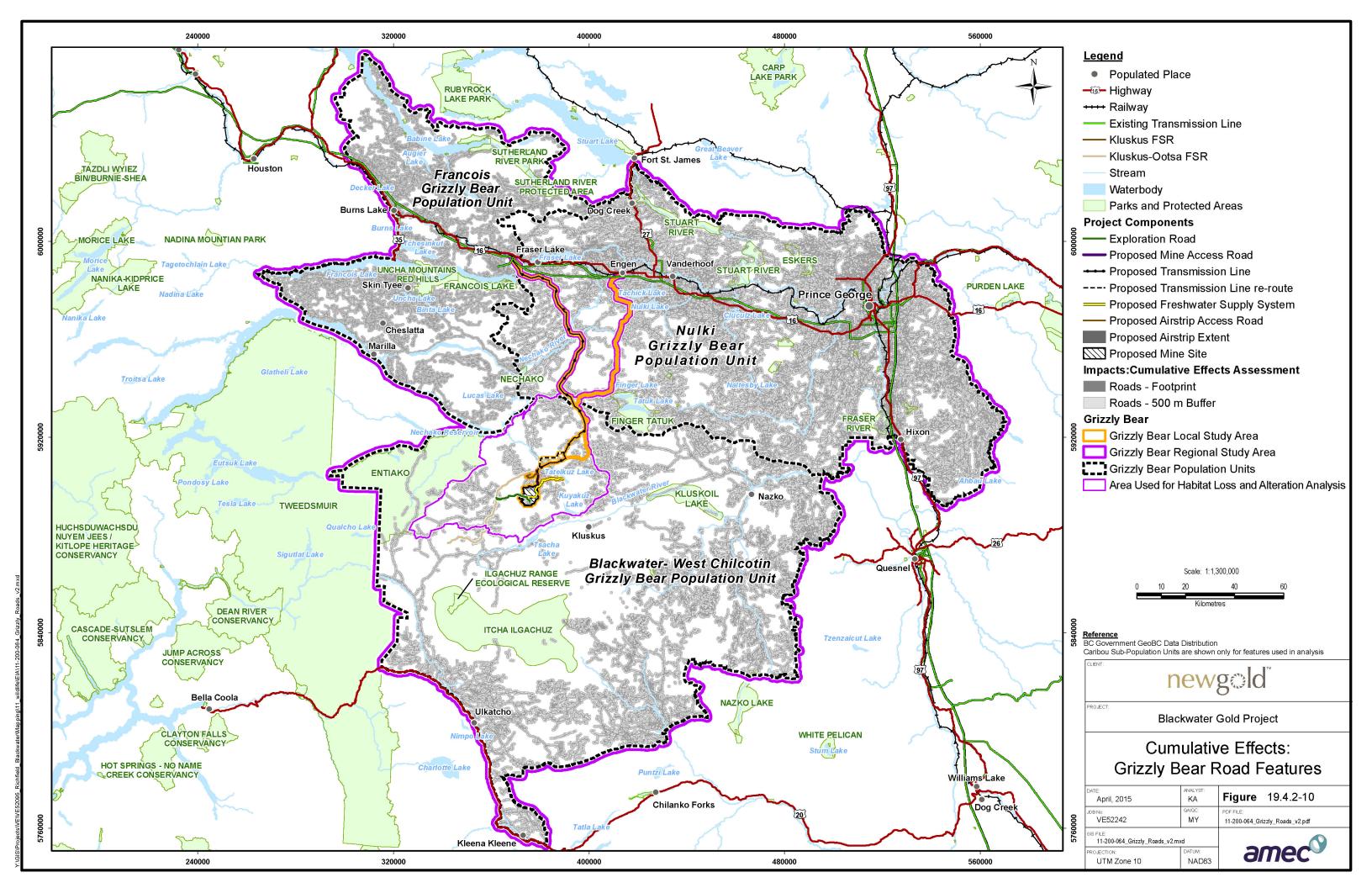


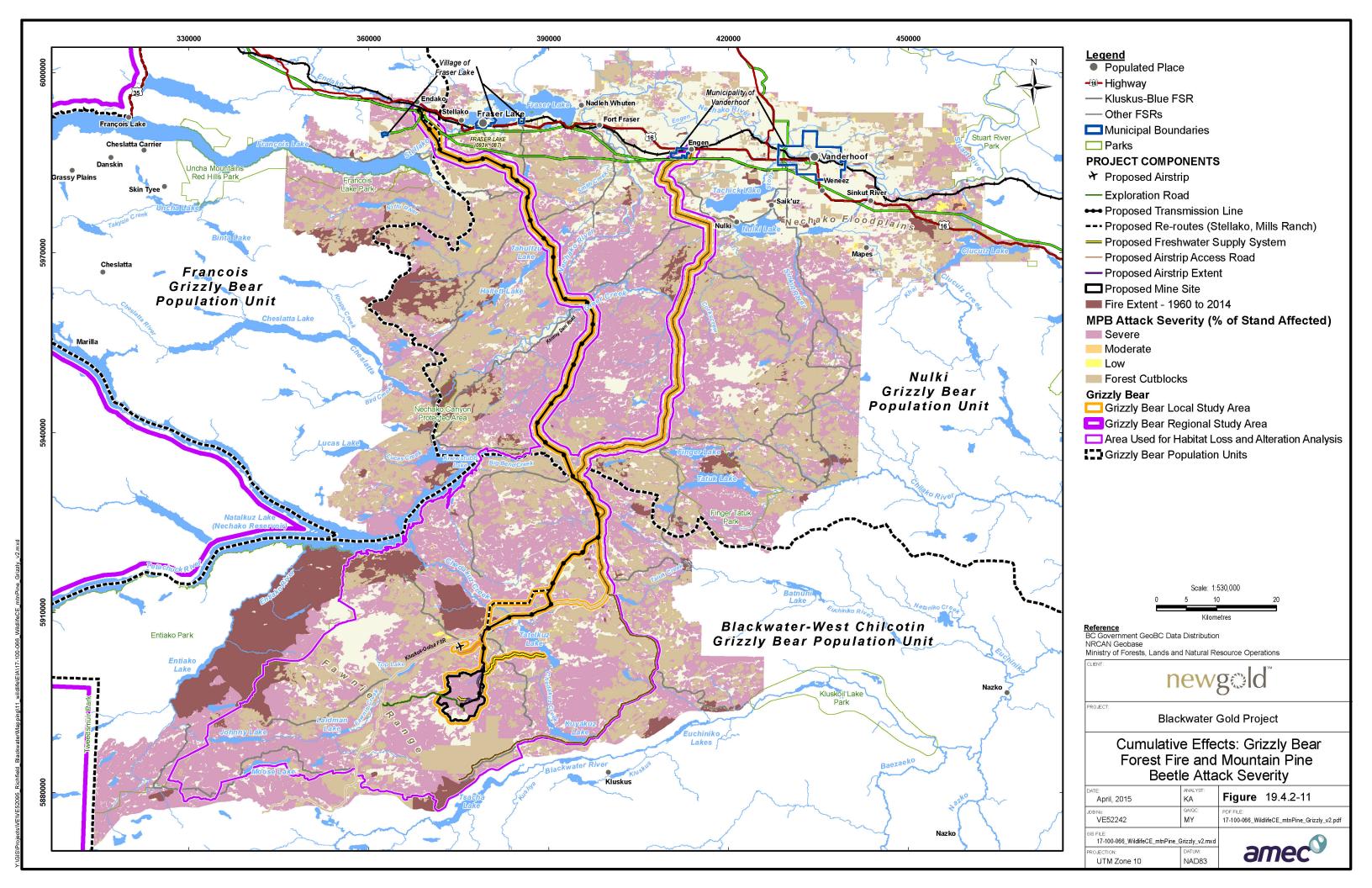
Table 19.4.2-50: Key and Moderate Interactions between Grizzly Bear Residual Effects and other Past, Present, and Future Projects/Activities

			Historical	Land Use	е	Re	epresentativ		nt and Fi		nd Use a	nd	Fores	onably eeable ects	
Project Phase	Residual Effect	Recreational (trails, fishing and lodges)	Forestry (cutblocks and woodlots)	Aboriginal Traditional Use	Hunting and Guide outfitting	Mining (active, current prospecting, quarries)	Recreational (sites, trails, fishing and lodges)	Forestry (cutblocks and woodlots)	Aboriginal Traditional Use	Hunting and Guide outfitting	Agriculture (Present)	Natural Disturbance (fire, MPB and blister rust)	Nulki Hills Wind Project	Agriculture (pending range tenures)	Carried Forward into CEA
Construction, Operations, and Closure	Habitat Loss	KI	KI	I	I	KI	KI	KI	I	I	KI	KI	I	KI	Yes
Construction, Operations, and Closure	Mortality Risk	KI	I	I	I	KI	KI	KI	I	I	I	I	I	I	Yes









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Agriculture is prevalent in the northern portion of the cumulative effects area and considered a major limitation to grizzly bears. Agricultural activities in the RSA will potentially degrade wetland and riparian habitat. Cattle grazing can alter wetland and riparian vegetation cover in emergent habitats, and potentially introduce invasive vegetation species. Trampling can compact wetland soils and cause erosion in riparian areas resulting in sedimentation of surface waters. Mechanical harvesting of wetland vegetation can cause rutting and soil displacement. Farms and other agricultural operations can result in reduced water quality in wetlands. Agricultural activities typically result in the loss of grizzly bear habitat as a result of habitat alteration and increased mortality due to conflicts with cattle ranching.

Mining activities (e.g., current prospecting, exploration) occur southeast and northwest of the mine site and are likely to continue into the future. Mineral prospecting can result in degraded grizzly bear habitat through noise pollution, vegetation removal, and invasive species. Mineral exploration in the area has increased the number of access roads, which have caused increased habitat fragmentation and road access for people. Increased traffic may result in vehicle collisions with grizzly bear.

Some of these activities are quantified for habitat loss and alteration and include mining activities (e.g., quarries and prospecting), forestry activities (e.g., cutblocks and woodlots), and forestry roads. The RSA is a total of 291,714 ha, of which 90,177 ha interacts these other activities and 160,462 ha interacts with natural disturbances (**Table 19.4.2-51**).

The activities included in **Table 19.4.2-52** were overlaid with the habitat rated moderate to high for grizzly bear in spring (**Table 19.4.2-52**), summer (**Table 19.4.2-53**), and late summer / fall (**Table 19.4.2-54**).

Table 19.4.2-51: Spatial Overlap of Grizzly Bear RSA by Source of Habitat Loss

Disturbance	Spatial Overlap with RSA	Temporal Overlap with RSA	Amount of Overlap (ha)
Nulki Hills Wind Project	Yes	Yes	2,896
Mining Activity	Yes	Yes	491 ⁽¹⁾
Forestry (cutblocks and woodlots) – past, present, and future	Yes	Yes	82,161
Forestry Roads	Yes	Yes	3,497
Fire	Yes	Yes	22,230
Mountain Pine Beetle ⁽³⁾	Yes	Yes	149,472
Total			249,507(2)

Note: (1) Current prospecting = 221 ha and Quarries = 202 ha

(2) The total does not equal the sum of the Projects because of overlap

(3) Mountain pine beetle infestations of \geq 10%;

ha = hectare; RSA = Regional Study Area



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Table 19.4.2-52: Cumulative Effects Spatial Overlap by Grizzly Bear Spring Season Habitat

Disturbance	Amount of Overlap with Moderate to High Habitat in RSA (ha)	Total Moderate to High Habitat in RSA (ha)	Amount of Overlap with Moderate to High Habitat in RSA (%)
Nulki Hills Wind Project	265	88,316	<1
Mining Activity	149	88,316	<1
Forestry (cutblocks and woodlots) past, present, and future	13,902	88,316	16
Forestry Roads (50 m)	563	88,316	<1
Forestry Roads (100 m)	3,601	88,316	4
Fire	3,110	88,316	4
Mountain Pine Beetle	54,571	88,316	62

Note: RSA = Regional Study Area; ha = hectare; % = percent; m = metre;

Table 19.4.2-53: Cumulative Effects Spatial Overlap by Grizzly Summer Season Habitat

Disturbance	Amount of Overlap with Moderate to High Habitat in RSA (ha)	Total Moderate to High Habitat in RSA (ha)	Amount of Overlap with Moderate to High Habitat in RSA (%)
Nulki Hills Wind Project	264	125,469	<1
Mining Activity	173	125,469	<1
Forestry (cutblocks and woodlots) past, present, and future	24,492	125,469	20
Forestry Roads (50 m)	1,181	125,469	1
Forestry Roads (100 m)	6,429	125,469	5
Fire	4,927	125,469	4
Mountain Pine Beetle	79,556	125,469	63

Note: RSA = Regional Study Area; ha = hectare; % = percent; m = metre



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Table 19.4.2-54: Cumulative Effects Spatial Overlap by Grizzly Late Summer/Fall Season Habitat

Disturbance	Amount of Overlap with Moderate to High Habitat in RSA (ha)	Total Moderate to High Habitat in RSA (ha)	Amount of Overlap with Moderate to High Habitat in RSA (%)
Nulki Hills Wind Project	297	136,664	<1
Mining Activity	214	136,664	< 1
Forestry (cutblocks and woodlots) past, present, and future	25,750	136,664	19
Forestry Roads (50 m)	1,241	136,664	1
Forestry Roads (100 m)	6,590	136,664	5
Fire	5,120	136,664	4
Mountain Pine Beetle	79,556	136,664	58

Note: RSA = Regional Study Area; ha = hectare; % = percent; m = metre

Approximately 16% of the moderate to high value spring season habitat within the RSA overlaps with forestry and mining activities in addition to the potential Project effects. There is a 32% overlap in moderate to high suitable summer habitat in the RSA and a 30% overlap of moderate to high suitable late summer / fall habitat within the RSA. MPB overlaps approximately 62% of the moderate to high value spring habitat within the RSA, as well as 63% of the summer habitat and 58% of the late summer / fall habitat and may result in habitat degradation if logged. Wildfires (including 2014) have impacted 88,998 ha (5%) of grizzly bear habitat within the Nulki population unit, 273,444 ha (13%) of grizzly bear habitat within the Blackwater population unit and 35,186 ha (4%) within the Francois population unit, including 1190 ha (5%) of habitat within the LSA and 22,230 ha (8%) of the RSA.

Table 19.4.2-56 summarizes the residual effect, extent, and duration of the historical, current, and future land use effects.

A WLMP was prepared for the Project to identify mitigation measures and options for all components and phases of the Project. Other management plans (e.g., Vegetation Management and Restoration, Sediment and Erosion Control) also provide other relevant mitigation measures. The Proponent is committed to following mitigation measures provided in the management plans to minimize adverse Project effects. If forestry, agricultural, and mineral prospecting practitioners in the RSA follow this guidance, potential effects of increased mortality, and changes in wildlife movement patterns and population dynamics resulting from these activities can be successfully mitigated through avoidance and minimization.

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Table 19.4.2-55: Potential Adverse Effects Resulting from Past, Present and Future Projects and Activities

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

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19.4.2.12.1.1 Cumulative Mortality Risk

Baseline linear feature densities in the three GBPUs are currently above the threshold of 0.6 km/km². The linear features include all road and transmission lines within the GBPU and were selected based on their accessibility by highway and off-road vehicles. Increases to densities from the Project are less than 0.3% increase; therefore, all three GBPUs will effectively remain at baseline densities.

19.4.2.12.2 Residual Cumulative Effects and Mitigation Measures

Recreation-related activities within the RSA will potentially degrade but not remove grizzly bear habitat, through increased human use of these areas and decreased bear use. Activities that may affect grizzly bear habitat include hunting, snowmobiling, off-road vehicle use, and camping.

Forestry-related activities in the GBPUs will potentially temporarily alter habitat availability through habitat conversion, noise pollution, erosion and sedimentation, invasive species introduction, and road avoidance (**Figure 19.4.2-10** and **Figure 19.4.2-11**). Forestry activities typically result in the removal of forested habitats. Wetland and riparian habitats are not usually removed; however, removal of forest surrounding these areas may cause degradation of these habitats.

Forestry-related activities in the Project area will degrade and remove high to moderate value grizzly bear habitat for all seasons. Suggested mitigation measures for forestry-related activities include:

- Following forest harvest guidelines, including cutblock and road design;
- Avoiding harvesting in wetland and riparian areas;
- Maintaining drainage pathways and wetland hydrology by installing appropriately sized culverts for stream and wetland crossings;
- Minimizing soil erosion and maximizing reforestation;
- Replanting with native vegetation to expedite succession;
- Implementing invasive plant control measures and monitoring systems; and
- Participation in regional initiatives to restore grizzly bear habitat and reduce mortality.

The MPB infestation has affected large areas of mature pine forest in the region, which may result in a loss of grizzly bear habitat if areas are accessed and logged. Some MPB-killed pine forest has been harvested while remaining forests are in various stages of degeneration due to the MPB. Mineral exploration in the area has increased the number of access roads, which have caused increased habitat fragmentation and road access for people. There is no hunting season in the Project area; however, the area is used by recreationalists who may impact grizzly bears by disturbance, displacement, and defence of life and property kills of grizzly bear. Agriculture is prevalent in the northern portion of the cumulative effects area and considered a major limitation to grizzly bears. Grizzly bear baseline information was collected in the LSA and portions of the RSA that were altered by these past and present activities. Current land and resource use activities in the Project Area are expected to continue in the future.



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Agricultural activities in the RSA will potentially degrade wetland and riparian habitat. Cattle grazing can alter wetland and riparian vegetation cover in emergent habitats, and potentially introduce invasive vegetation species. Trampling can compact wetland soils and cause erosion in riparian areas resulting in sedimentation of surface waters. Mechanical harvesting of wetland vegetation can cause rutting and soil displacement. Farms and other agricultural operations can result in reduced water quality in wetlands. Similar to forestry activities, agricultural activities do not typically result in the loss of grizzly bear habitat but may result in temporary habitat alteration.

Agriculture-related activities in the Project area will degrade and remove high to moderate value grizzly bear habitat for all seasons. Suggested mitigation Best Management Practice measures for agricultural-related activities include:

- Establishing cattle exclusion zones to limit grazing to uplands, thereby minimizing erosion and sedimentation:
- Minimizing pesticide and fertilizer use around aquatic resources and before precipitation events to limit chemical runoff from entering wetlands;
- Establishing protected riparian areas prior to clearing; and
- Controlling invasive species.

Natural disturbances, such as the MPB infestation, have contributed to the declining health of lodgepole pine forests within the GBPUs and increased access for logging. Further degradation of moderate and high value grizzly habitat may occur with a 58% loss of pine forest overlapping moderate to high value late summer / fall habitat and 63% loss of pine forest overlapping moderate to high value summer habitat in the RSA (**Figure 19.4.2-11**). Fire has affected 7.6% (22,230 ha) of the RSA, and is expected to affect grizzly habitat in the future. Fire and MPB both contribute to an increase in forest canopy openings that result in an increase in shrubs and forbs until forests regenerate, creating suitable feeding habitat for grizzly bears. The main concern for grizzly bear habitat is the maintenance of security and thermal cover, typically mature forest, near good feeding areas.

Wildfires have impacted 22,230 ha (8%) of the RSA and 1190 ha (5%) of the LSA of grizzly bear range. MPB has impacted over 60% of suitable grizzly bear habitat in the RSA. The named projects from the project inclusion list in that represent present and future projects will not have interactions with the Project however the listed activities from the list will. Pre-existing habitat loss and fragmentation due to logging and road development has altered the higher suitability low elevation habitat within the Project area (see **Table 19.4.2-55**). The mountain pine beetle has infested large areas of mature pine forest in the region including the LSA and RSA, some of which was harvested while remaining forests are in various stages of regeneration. Logging and mineral exploration in the area increased the number of access roads. Grizzly bear baseline information was collected in the study areas that have been altered by these past and present activities. Wildfire in 2014 has recently altered large portions of the MPB infested areas of the RSA and reduced overall suitable habitat. The future activities in the RSA are expected to include similar activities. With the increase of industrial and agricultural activities, loss of effective habitat may result in less suitable areas for grizzly bear.



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Table 19.4.2-56: Assessment of Spatial and Temporal Overlap between the Project and Other Projects and Human and Ecological Actions with Ecosystem Composition

	Interaction	Residual Environmental Effect	Extent	Duration	Rationale	Cumulative Effect (Contribution from Project or Overlap)
	Forestry Activities	Change in baseline ecosystems	Regional	Chronic	Forestry companies operate within the RSA, habitat change and loss of security cover	Yes
Historical Land Use	Recreation Disturbance		Regional	Chronic	Trails and other access routes in the RSA, incidental mortality of grizzly	Yes
	Trapping and Guiding	Disturbance and mortality	Regional	Chronic	There is a moratorium on hunting in all three of the GBPU within the RSA*	No
	Traditional Land Use	Change in baseline ecosystems	Regional	Chronic	Aboriginal groups are present within the RSA	Yes
	Forestry Activities	Change in baseline ecosystems following forestry	Regional	Chronic	Forestry companies will continue to pursue logging operations including MPB salvage	Yes
Representative Current and Future Land Use	Traditional Land Use	Change in baseline ecosystems	Regional	Chronic	A reclamation plan for revegetation is in place	Yes
	Mining	Change in baseline ecosystems	Regional	Chronic	Mining projects will continue in the RSA	Yes
	Recreation	Disturbance	Regional	Chronic	Recreation will continue in the RSA	Yes

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Interaction	Residual Environmental Effect	Extent	Duration	Rationale	Cumulative Effect (Contribution from Project or Overlap)
Mountain Pine Beetle	Change in baseline ecosystems	Regional	Chronic	Infestation reduces the number of healthy trees that provide security and thermal cover (minor proportion of dead trees)	Yes
Fire	Change in baseline ecosystems following forestry	Regional	Chronic	Fire will remove potential security habitat	Yes

Note: RSA = Regional Study Area; GBPU = Grizzly Bear Population Unit; MPB = mountain pine beetle

Mining-related activities in the Project area will degrade and remove high to moderate value grizzly bear habitat for all seasons. Suggested mitigation measures for mineral exploration and prospecting, which are typical permit conditions under the *Mines Act* (Government of BC, 1996b), will include:

- Pre-planning to avoid wetlands and minimizing stream crossings for access roads;
- Avoiding work during critical breeding and rearing seasons for grizzly bear;
- Limiting the production of excess drilling fluids; and
- Avoiding discharges of drilling fluids into wetland and riparian habitat.

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

Broad regional collaborative measures may include:

- Maximizing reforestation particularly in MPB and wildfire-affected areas;
- Developing and implementing operating guidelines for industrial development and access within grizzly bear habitat;
- Participating in land-use planning to identify areas within grizzly bear habitat where grizzly bear conservation is prioritized;
- Maintaining hunting closures and restrictions in areas that remain open to hunting;
- Reducing speed zones on road sections in important grizzly bear habitat;



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- Developing cooperative stewardship agreements, memoranda of understanding, and activities to support the engagement of Aboriginal organizations, recreational stakeholders, and other stakeholders in the monitoring, management, and conservation of grizzly bears;
- Preparing and providing outreach materials relating to grizzly bear and distribution to interest groups, recreational organizations, and the general public, including education on how to avoid disturbing grizzly bears; and
- Supporting ongoing research relating to grizzly bear habitat, ecology, and limiting factors.

19.4.2.12.3 Significance of Residual Cumulative Effects

The significance of the Project's contribution to cumulative effects in the RSA was determined at the post-closure phase for this assessment as habitat mitigation and compensation will occur primarily during closure. Logging activities in the RSA have increased grizzly bear mortality and generated loss of habitat; however, application of BMPs (BC MFLNRO, 2014) will reduce the potential for any future increases in grizzly bear mortality and protect key habitats. Although Project effects and the effects of other activities in the RSA may be cumulative, the Project is not expected to affect the viability of this species due to the widespread and common extent of grizzly bears and their habitat within the RSA. Cumulative effects for habitat loss and alternation are anticipated to be Not Significant (minor).

Baseline levels of linear disturbance are currently above the threshold (i.e., >0.6 km/km²) identified by BC MFLNRO (2012), on this basis alone the existing effects on grizzly bears within these three GBPUs may be considered Significant (**Table 19.4.2-57**). Due to the minimal increase in mortality associated with forestry, agricultural, and mineral exploration activities, and the implementation of mitigation measures by the Proponent to minimize potential effects of the Project on bear mortality, the overall cumulative effects remain unchanged with the addition of the Project. Because the Project is predicted to increase linear density by no more than 0.1 to 0.3% in the GBPUs, its contribution to cumulative effects is conservatively rated as Not Significant (minor). The level of confidence is moderate due to the implementation of the grizzly bear mitigation measures.



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Table 19.4.2-57: Post-Closure Residual Cumulative Effects Assessment on Grizzly Bear Mortality and Loss of Grizzly Bear Habitat

Effect Attribute	Current/Future Cumulative Environmental Effect(s) without Project	Current/Future Cumulative Environmental Effect(s) with the Project	Project Contribution to Cumulative Environmental Effects
	Habitat Loss and A	Iteration	
Context	Medium	Medium	Low
Magnitude	High	High	Low
Geographic Extent	Regional	Regional	Local
Duration	Chronic	Chronic	Chronic
Reversibility	Yes	Yes	Yes
Frequency	Continuous	Continuous	Continuous
Likelihood Determination	High	High	Moderate
Level of Confidence for Likelihood	High	High	High
Significance Determination	Not Significant (minor)	Not Significant (minor)	Not Significant (minor)
Level of Confidence for Significance	Moderate	Moderate	Moderate
	Mortality Ris	sk	'
Context	Medium	Medium	Low
Magnitude	High	High	Low
Geographic Extent	Regional	Regional	Regional
Duration	Chronic	Chronic	Chronic
Reversibility	Yes	Yes	Yes
Frequency	Continuous	Continuous	Intermittent
Likelihood Determination	High	High	Moderate
Level of Confidence for Likelihood	High	High	High
Significance Determination	Significant	Significant	Not Significant (minor)
Level of Confidence for Significance	Moderate	Moderate	Moderate

19.4.2.12.4 Limitations

The effects assessment for grizzly bear is based on the information presented within the current Project Description. The Project footprint, mine site facilities, and areas disturbed were assumed based on the current Project designs. The key limitation of this assessment is the limited surveys to quantify the presence of grizzly bears within the RSA as they occur at low densities and have large home ranges. This limitation was offset with extensive grizzly surveys over three years for the Project (2011 through 2013). Calculation of estimated impacts on habitat in areas outside of the LSA is limited due to lack of detailed habitat data for PEM and areas in the GBPUs. Regional abundance is not known beyond habitat suitability models and professional judgment.



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19.4.2.12.5 Conclusions

Grizzly bears will be adversely affected through loss and alteration of habitat and increased mortality during the life of the Project, but adverse effects will be largely reversed during post-closure once closure and reclamation measures are implemented.

The potential Project residual effects include habitat loss and degradation of a small amount of moderate to high value habitat for grizzly bear, and increased mortality caused by an increase in road density and vehicle traffic along the Kluskus FSR. These effects will be caused primarily by the construction and widening of roads, the development of the airstrip, freshwater pipeline, and mine site, and the clearing for the transmission line. Mortality risk is considered Not Significant (minor), primarily due to the limited extent and low magnitude of Project activity that overlaps baseline grizzly bear habitats. Mitigation measures to address these effects include monitoring of Kokanee spawning streams, restoration of habitats following closure, and adaptive management, such as signage, speed limits, and temporary avoidance of areas where bears are active to minimize risk of collisions due to the Project. After considering mitigation measures, the temporal loss of grizzly bear habitat remains a residual effect rated as Not Significant (minor), as there will be a 2% to 4% reduction in habitat at post-closure within the mine site.

The cumulative effects of forestry, agriculture, mineral exploration, and the Project on grizzly bear habitat loss and mortality was assessed for the RSA. The contribution of the Project to cumulative effects on grizzly bear habitat loss and mortality is predicted to be Not Significant (minor) within the RSA as a result of mitigation measures such as BMPs (BC MFLNRO, 2014).

19.4.2.13 Furbearers

A CEA for the furbearer VC is necessary because the Project is expected to have a Not Significant (minor) residual adverse effect on marten habitat loss and degradation, and a Not Significant (minor) residual adverse effect on beaver risk of mortality. Residual effects on marten habitat or beaver mortality that could arise from other projects or activities in the region are assessed to fully understand the context of the residual adverse effects on furbearers by the Project. The spatial boundary for this assessment is the RSA. The temporal boundaries include historical, present, and certain and reasonably foreseeable projects within the RSA. Rationale for carrying forward into the CEA is shown in **Table 19.4.2-58**.



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Table 19.4.2-58: Project Related Residual Effects; Rationale for Carrying Forward into the CEA

Project Component	Project Phase	Residual Effect	Rationale	Carried Forward to Cumulative Effects Assessment
Mine site, airstrip, transmission line, freshwater supply pipeline, and access roads	Construction through to Closure	Unavoidable loss or alteration of habitat for furbearers	Changes in the amount of habitat from baseline conditions	Yes
Mine Site, Airstrip, Transmission Line, Freshwater Supply Pipeline, and Access Roads	Construction through to Closure	Unavoidable mortality of beaver	Changes in mortality	Yes

The MPB infestation has affected large areas of mature pine forest in the region, which has resulted in a loss of furbearer habitat. Some MPB-killed pine forest was harvested while remaining forests are in various stages of degeneration due to the MPB. Mineral exploration in the area has increased the number of access roads, which have caused increased habitat fragmentation and road access for people. There is no hunting season in the Project area; however, the area is used by trappers and recreationalists who may impact furbearers by causing mortality, disturbance, and displacement. Agriculture is prevalent in the northern portion of the cumulative effects area and considered a limitation to furbearers. Baseline information was collected in the LSA and portions of the RSA that were altered by these past and present activities. The future activities in the Project area are expected to include similar activities. For assessing cumulative effects for mortality of beaver CEA, the most relevant land uses in the RSA that could potentially interact include forestry, mining, and agriculture activities. **Table 19.4.2-59** presents identified interactions between past, present, and future projects and land uses in the RSA.

Table 19.4.2-59: Key and Moderate Interactions between Furbearers and other Past, Present, and Future Projects/Activities

	Histor	ical Land	d Use		sentative Future La		and	
Potential Residual Effect	Forestry (cutblocks and woodlots)	Agriculture (range tenures	Trapping and Hunting	Mining (active, current prospecting,	Forestry (cutblocks and woodlots)	Agriculture (active range tenures)	Trapping and Hunting	Carried Forward into CEA?
Habitat Loss and Alteration	I	I	I	I	I	I	I	Yes
Mortality Risk	I	I	I	I	I	I	I	Yes

Note: I = interaction, KI = key interaction, NI = no interaction



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A Wildlife Management Plan has been developed for the Project to provide mitigation for all components and phases of the Project. For the furbearer CEA, the most relevant land uses in the RSA that could potentially interact with furbearer habitat and mortality include forestry, mining, trapping, and agriculture activities. No singular reviewable projects were identified within the RSA. Current mineral prospecting could lead to mine projects in the future, but hypothetical projects are not to be considered during the CEA (BC EAO, 2013). **Table 19.4.2-59** presents the identified interactions between past, present, and future projects and land uses in the RSA for the CEA.

19.4.2.13.1 Potential Residual Cumulative Effects and Mitigation Measures

Forestry-related activities within the RSA will potentially temporarily alter and degrade furbearer habitat through habitat conversion, erosion and sedimentation, and invasive species introduction. Forestry activities typically result in the removal of forested habitats. Wetland and riparian habitats are not usually removed; however, removal of forest surrounding these areas may cause the degradation of these habitats.

Suggested mitigation measures for forestry activities include: 1) follow forest harvest guidelines, retention of snags and wildlife trees, including cutblock and road design to minimize erosion and maximize reforestation; 2) maintain buffers around wetlands, riparian areas; 3) apply sediment control to areas around wetlands and other waterbodies; 4) implement invasive plant control measures and monitoring systems; 5) and replant native vegetation to expedite succession. These mitigation activities are described in the environmental management plans for the Project (Section 12.2.1 of the Application).

Agricultural activities in the RSA will potentially degrade furbearer habitat. Conversion of forest to agricultural crops or cattle pasture either severely degrades or results in the loss of furbearer habitat. Cattle grazing can degrade wetland and riparian vegetation, and potentially introduce invasive vegetation species. Trampling can compact wetland soils and cause erosion in riparian areas resulting in sedimentation of surface waters. Mechanical harvesting of wetland vegetation can cause rutting and soil displacement. Farms and other agricultural operations can result in reduced water quality in wetlands through fertilizer and pesticide use. Similar to forestry activities, agricultural activities do not typically result in the loss of furbearer habitat but may result in degraded furbearer habitat.

Suggested mitigation measures for agricultural activities include: 1) establishing cattle exclusion zones to limit grazing to uplands, thereby minimizing erosion and sedimentation; 2) minimizing pesticide and fertilizer use around aquatic resources and before precipitation events to limit chemical runoff from entering wetlands; 3) establishing protected riparian areas prior to clearing; and 4) controlling invasive species.

Mining activities (e.g., current prospecting, exploration) are occurring southeast and northwest of the mine site, and are likely to continue into the future. Mineral prospecting can result in degraded furbearer habitat through accidental discharge of drilling fluids and vegetation removal, and may result in an increase in mortality, either through increased access to beaver habitat or mortality from



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spills. Hunting and trapping may cause disturbance within furbearer habitat, and may degrade these areas.

Suggested mitigation measures for mineral exploration and prospecting, which are typical permit conditions under the *Mines Act* (Government of BC, 1996b), include: 1) pre-planning to avoid wetlands and minimizing stream crossings for access roads; 2) avoiding work during critical breeding and rearing seasons for wildlife; 3) limiting the production of excess drilling fluids; 4) maintaining buffers around wetlands and riparian areas; and 5) avoiding discharges of drilling fluids into aquatic systems.

19.4.2.13.2 Significance of Potential Residual Cumulative Effects

The Project will contribute to additional loss of furbearer habitat and increase in beaver mortality in combination with the past, present, and future activities (e.g., forestry, agricultural, and mineral exploration) identified in the RSA for this CEA. The significance of the Project's contribution to cumulative effects in the RSA was determined at the post-closure phase for this assessment as forests and other habitats will be mitigated through reclamation primarily during closure. Logging activities in the RSA have likely caused some loss of marten habitat; however, application of BMPs (BC MFLNRO, 2014) will protect key forest and wetland habitats needed by furbearers. Although Project effects and the effects of other activities in the RSA may be cumulative, no additional adverse residual effects on furbearers are anticipated due to the Project. Due to the minimal loss of furbearer habitat associated with forestry, agricultural, and mineral exploration, the significance determination for residual cumulative effects is Not Significant (minor) as a result of Project implementation (Table 19.4.2-60) because of the mitigation and compensation measures for the Project and forestry management practices to reclaim forest cover. Due to the minimal increase in beaver mortality associated with forestry, agricultural, and mineral exploration, the significance determination for residual cumulative effects is Not Significant (minor) as a result of Project implementation (Table 19.4.2-61) because of the mitigation and compensation measures for the Project.

Table 19.4.2-60: Residual Cumulative Effects Assessment for Loss of Furbearer Habitat

Effect Attribute	Current/Future Cumulative Environmental Effect(s) without Project	Cumulative Environmental Effect with Project
Context	Medium	Medium
Magnitude	Low	Negligible
Geographic Extent	Regional	Local
Duration	Long Term	Chronic
Reversibility	Yes	Yes
Frequency	Intermittent	Once
Likelihood Determination	High	High
Level of Confidence for Likelihood	High	High
Significance Determination	Not Significant (minor)	Not Significant (minor)
Level of Confidence for Significance	High	High



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Table 19.4.2-61: Residual Cumulative Effects Assessment for Beaver Mortality

Effect Attribute	Current/Future Cumulative Environmental Effect(s) without Project	Cumulative Environmental Effect with Project
Context	Low	Low
Magnitude	Low	Negligible
Geographic Extent	Regional	Local
Duration	Long Term	Long term
Reversibility	Yes	Yes
Frequency	Intermittent	Intermittent
Likelihood Determination	Moderate	Low
Level of Confidence for Likelihood	High	High
Significance Determination	Not Significant (minor)	Not Significant (minor)
Level of Confidence for Significance	High	High

19.4.2.13.3 Limitations

The effects assessment for furbearers is based on the information presented within the current Project Description. The Project footprint, mine site facilities, and areas disturbed were assumed based on the current Project designs. The key limitation of this assessment is the cyclic population numbers of furbearers. Regional abundance and habitat use are not known beyond habitat suitability models and professional judgment.

19.4.2.13.4 Conclusions

Furbearers will be adversely affected through loss and degradation of habitat and increased mortality risk during the life of the Project but are expected to return to near baseline conditions upon post-closure. Due to the minimal loss of furbearer habitat associated with forestry, agricultural, and mineral exploration, the significance determination for residual cumulative effects is Not Significant (minor) and the project residual effects are determined to be Not Significant (negligible to minor).

The potential Project residual effects include habitat loss and degradation of a small amount of moderate to high value habitat for furbearers. These effects will be caused primarily by the construction and widening of roads, the development of the airstrip, freshwater pipeline, and mine site, and the clearing for the transmission line. The maximum extent of habitat effects is considered local in context, with the loss pertaining to the clearing limits and degradation within 50 m of those limits.

Mitigation and adaptive management plans will avoid and mitigate the majority of adverse effects. Where it is not possible to mitigate completely, the effects will be minimized to keep the magnitude of effects at negligible to low. Mitigation measures for minimizing habitat and mortality effects on furbearers include no net loss of wetland habitat, reclamation and revegetation, no firearms or hunting on the Project tenure, and access management plans to mitigate human and predator



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access on linear clearings. Mortality and health effects on furbearers were considered only for beaver, primarily because of the limited extent and magnitude of Project activity that overlaps key furbearer habitats. Additional mitigation measures to minimize residual effects on beavers include:

- Maintain quantity and quality of mature and old-growth forest cover;
- Apply wildlife management plan measures to road use agreements with other commercial users of the access roads;
- Close and decommission access roads and trails after mine closure and reclamation are achieved; and
- Conduct habitat restoration of existing disturbed habitats affected by the current road and transmission line, including closure and decommissioning spur roads/trails.

19.4.2.14 Invertebrates

A CEA for the Invertebrate VC is necessary because the Project is expected to have a Not Significant (minor) residual effect of invertebrate habitat loss and degradation. Residual effects on invertebrate habitat that could arise from other projects or activities in the region should be assessed to fully understand the context of the residual adverse effects on invertebrates by the Project. The spatial boundary for this assessment is the RSA. The temporal boundaries include historical, present, and certain and reasonably foreseeable projects within the RSA. Rationale for carrying forward into the CEA is shown in **Table 19.4.2-62**.

Table 19.4.2-62: Project Related Residual Effects; Rationale for Carrying forward into the CEA

Project Component	Project Phase	Residual Effect	Rationale	Carried Forward to Cumulative Effects Assessment
Mine site, airstrip, transmission line, freshwater supply pipeline, and access roads	Construction through to Closure	Unavoidable loss or alteration of habitat	Changes in the amount of habitat from baseline conditions	Yes

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

For the invertebrate CEA, the most relevant land uses in the RSA that could potentially interact with invertebrate habitat include forestry, mining, and agriculture activities. No singular reviewable projects were identified within the RSA. Current mineral prospecting could lead to mine projects in the future, but hypothetical projects are not to be considered during the CEA (BC EAO, 2013). Identified interactions between past, present, and future projects and land uses in the RSA for the CEA are presented in **Table 19.4.2-63**.



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Table 19.4.2-63: Key and Moderate Interactions between Invertebrates and other Past, Present, and Future Projects/Activities

	Historical	Land Use	Represe Fu			
Potential Residual Effect	Forestry (cut blocks and woodlots)	Agriculture (range tenures	Mining (active, current prospecting, quarries)	Forestry (cut blocks and woodlots)	Agriculture (active range tenures)	Carried Forward into CEA?
Loss of Invertebrate Habitat	I	I	I	I	I	Yes

Note: I = interaction, KI = key interaction, NI = no interaction

19.4.2.14.2 Potential Residual Cumulative Effects and Mitigation Measures

Forestry activities in the RSA have the potential to temporarily alter and degrade invertebrate habitat through habitat conversion, erosion and sedimentation, and invasive species introduction. Although forestry activities do not typically result in loss of invertebrate habitat, the temporary effects on invertebrate habitat from current and future forestry activities could result in the temporary degradation of invertebrate habitat.

Forestry activities in the study areas will likely result in degrading and removing some moderate to high value invertebrate habitat. Suggested mitigation measures such as Guidelines and BMPs in BC (BC MFLNRO, 2014) include: maintaining drainage pathways and wetland hydrology by installing appropriately sized culverts for stream and wetland crossings; avoiding harvesting in wetland and riparian areas; replanting native vegetation to expedite succession; road design to minimize erosion and maximize reforestation; maintaining buffers around wetlands and riparian areas; applying sediment control to areas around wetlands and other waterbodies; and implementing invasive plant control measures and monitoring systems. Given the adherence to these practices, the loss of invertebrate habitat to forestry is expected to be minor.

Agricultural activities in the RSA have the potential to cause the loss and degradation of invertebrate habitat. Conversion of natural habitat to agricultural habitat typically results in the loss of wildlife habitat and many species of invertebrates. Cattle grazing can alter invertebrate habitat in emergent habitats, and potentially introduce invasive vegetation species. Trampling can compact soils and cause erosion in riparian areas resulting in sedimentation of surface waters. Mechanical harvesting of vegetation can cause rutting and soil displacement. Farms and other agricultural operations can result in reduced water quality in invertebrate habitat due to fertilizer and pesticide use. Agricultural activities do not typically result in the direct loss of invertebrate habitat but may result in degraded invertebrate habitat.

Suggested mitigation measures for agricultural activities include: 1) establishing cattle exclusion zones to limit grazing to uplands, thereby minimizing erosion and sedimentation; 2) minimizing pesticide and fertilizer use around aquatic resources and before precipitation events to limit



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chemical runoff from entering watersheds; 3) establishing protected riparian areas prior to clearing; and 4) controlling invasive species.

Mining activities (e.g., current prospecting, exploration) occur southeast and northwest of the proposed mine site, and are likely to continue into the future. Mineral prospecting can result in degraded invertebrate habitat through accidental discharge of drilling fluids, vegetation removal, and invasive species introduction.

Suggested mitigation measures for mineral exploration and prospecting, which are typical permit conditions under the *Mines Act* (Government of BC, 1996b), include: 1) pre-planning to avoid important wildlife areas (e.g., wetlands; 2) minimizing stream crossings for access roads; 2) avoiding work during critical breeding and rearing seasons for wildlife; 3) limiting the production of excess drilling fluids; and 4) avoiding discharges of drilling fluids into aquatic systems.

19.4.2.14.3 Significance of Potential Residual Cumulative Effects

The significance of the Project's contribution to cumulative effects in the RSA was determined at the post-closure phase for this assessment as forest and other habitat mitigation and compensation will occur primarily during closure.

The Project will contribute to additional loss of invertebrate habitat in combination with the past, present, and future activities (e.g., forestry, agricultural, and mineral exploration) identified in the RSA for this CEA. The significance of the Project's contribution to cumulative effects in the RSA was determined at the post-closure phase for this assessment as wetlands mitigation and compensation will occur prior to and concurrent with construction, and during operations and closure. Logging activities in the RSA have generated loss of habitat; however, application of BMPs (BC MFLNRO, 2014) will protect the key wetland habitats needed by invertebrate species by minimizing disturbance, increasing success of reforestation, and minimizing the duration of disturbance. Due to the minimal loss of invertebrate habitat associated with forestry, agricultural, and mineral exploration, the significance determination for residual cumulative effects is Not Significant (minor) as a result of Project implementation (**Table 19.4.2-64**) because of the mitigation and compensation measures for the Project. The level of confidence is moderate due to the risk associated with the invertebrate habitat mitigation measures.



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Table 19.4.2-64: Residual Cumulative Effects Assessment for Loss of Invertebrate Habitat

Effect Attribute	Current/Future Cumulative Environmental Effect(s) without Project	Project Contribution Cumulative Environmental Effect
Context	Medium	Medium
Magnitude	Low	Low
Geographic Extent	Regional	Local
Duration	Chronic	Chronic
Reversibility	Yes	Yes
Frequency	Intermittent	Once
Likelihood Determination	High	High
Confidence Level for Likelihood	High	High
Significance Determination	Not Significant (minor)	Not Significant (minor)
Confidence Level for Significance	Moderate	Moderate

19.4.2.14.4 Limitations

The key limitation of this assessment is the limited surveys to quantify the invertebrate species presence over time as some species have cyclic population numbers. Regional abundance and habitat use are not known beyond habitat suitability models and professional judgment.

19.4.2.14.5 Conclusions

Invertebrates will be adversely affected through loss and degradation of habitat during the life of the Project. There is a high probability that lost habitat will recover to average baseline conditions upon closure, except limited portions of the airstrip and access roads. Loss and degradation effects include effects from direct habitat loss due to Project construction, dust deposition on vegetation and soil, and invasive species introduction and/or spread scale.

The potential residual effects of habitat loss and degradation will be primarily caused by the construction of new portions of the road; widening along the existing FSR; airstrip, freshwater pipeline, and mine site development; and clearing for the transmission line. Degradation will occur from all Project components. The maximum extent of these effects is local in context, with the loss pertaining to the clearing limits and degradation within 50 m of those limits, although the majority of the degrading effects will occur within 10 m to 30 m from the road edges.

Mitigation and adaptive management plans will avoid and mitigate the majority of adverse effects. Where it is not possible to mitigate completely, the effects will be minimized to keep the magnitude of effects at a maximum of low, with the majority at a negligible to low level. The most important mitigation measures for minimizing residual effects to invertebrates include:

 Maintain quantity and quality of adjacent wetlands and forest cover, particularly black spruce and sedge wetlands;



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- Apply wildlife management plan measures to road use agreements with other commercial users of the access roads;
- Close and decommission access roads and trails after mine closure and reclamation are achieved; and
- Conduct habitat restoration of existing disturbed habitats affected by the current road and transmission line, including closure and decommissioning spur roads/trails.

19.4.3 Social VCs

19.4.3.1 Non-traditional Land and Resource Use

This subsection determines the need for assessing cumulative effects and assesses potential cumulative effects;

Residual effects within the six study areas and two transmission line alternatives (i.e., Stellako and Mills Ranch re-routes) include disturbances to the land base and disruption of various NTLU activities. These residual effects (i.e., effects of noise and dust-related aesthetics on private lands, effects to non-consumptive (general outdoor recreation) recreation activities, mining, prospects, exploration, quarries, gravel pits and mineral tenures, forestry, trapping and fishing and range tenures); of the Project are carried forward for a cumulative effects assessment (CEA) to assess effects in combination with the residual effects of one or more other Projects or human activities (Table 19.4.3-1 and Table 19.4.3-2).

Table 19.4.3-1: Project-Related Residual Effects; Rationale for Carrying Forward into the CEA

Project Component	Project Phase	NTLU Key Indicators	Rationale	Carried Forward in Cumulative Effects Assessment
Mine site, airstrip, transmission line, freshwater supply pipeline and access roads	C, O, D/C	Recreation/Tourism Use	Disruption to recreational activities	Yes
Mine site, airstrip, transmission line, freshwater supply pipeline and access roads	C, O, D/C	Mining Exploration and Mineral Tenures	Land Base disturbance will occur	Yes
Mine site, airstrip, transmission line, freshwater supply pipeline and access roads	C, O, D/C	Forestry and Timber Resource Use	Disturbance and disruption to forestry land base and related activities	Yes



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Project Component	Project Phase	NTLU Key Indicators	Rationale	Carried Forward in Cumulative Effects Assessment
Mine site, airstrip, transmission line, freshwater supply pipeline and access roads	C, O, D/C	Hunting, Trapping, and Guide Outfitting	Land base disturbance and disruption to hunting, trapping and guide-outfitting activities	Yes
Mine site, airstrip, transmission line, freshwater supply pipeline and access roads		Fishing and Aquaculture	No Project Effect	No
Mine site, airstrip, transmission line, freshwater supply pipeline and access roads	C, O, D/C	Agriculture and Grazing	Minimal disruption to range land tenures will occur	Yes
Mine site, airstrip, transmission line, freshwater supply pipeline and access roads		Land Ownership	Negligible effects to Land Act tenures will be mitigated	No
Mine site, airstrip, transmission line, freshwater supply pipeline and access roads	C, O, D/C	Land Ownership (Private Lands)	Residual noise and dust disturbance and access related disruption will affect residents and community members	Yes
Transmission line	C, O, D/C	Surface Water and Groundwater Resource Use	Negligible Project effects to two water licences will be mitigated	No
Mine site, airstrip, transmission line, freshwater supply pipeline and access roads	C, O, D/C	Recreational and Commercial Use of Waterways	Negligible Project effects will be mitigated	No
Mine site, airstrip, transmission line, freshwater supply pipeline and access roads	C, O, D/C	Transportation and Access	Project related Transportation and access related effects will occur throughout the life of the Project within the LSA	Yes

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



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Table 19.4.3-2: Interactions between NTLU and other Past, Present, and Future Projects/Activities

	Historical Land Use					Representative and Current Land Use Future Land Use						Future Land Use				
NTLU Key Indicators	Forestry (cutblocks and woodlots)	Agriculture and Rangeland tenures	Recreational (trails, fishing and lodges)	Trapping and guide outfitting	Tenures (Mining (quarries, water)	Transportation and Access	Natural disturbance (Fire and MPB)	Forestry (cutblocks and woodlots)	Agriculture and Rangeland tenures	Recreational (trails, fishing and lodges)	Trapping and guide outfitting	Tenures (Mining (quarries, water)	Transportation and Access	Natural disturbance (Fire and MPB)	Nulki Hills Project, Fraser Lake Biomass Project, future mineral and Crown tenures, and logging activities	Carried Forward into CEA?
Recreation/Tourism Use	I	I	I	I	I	I		I	I	I	I	ı	ı	I	I	Yes
Mining Exploration and Mineral Tenures	I	I	I	I	I		NI	I	I	I	I	ı	I	I	I	Yes
Forestry and Timber Resource Use	I	I	I	I	I	I	I	I	I	I	ı	ı	I	I	I	Yes
Hunting, Trapping, and Guide Outfitting	I	I	NI	I	I	I	I	I	ı	I	I	ı	I	I	I	Yes
Fishing and Aquaculture	NI	NI	I	NI	NI	NI	NI	NI	NI	I	NI	NI	NI	NI	NI	No
Agriculture and Grazing	NI	I	NI	NI	NI	I	NI	I	NI	NI	NI	NI	NI	NI	I	Yes
Land Ownership	I	NI	NI	NI	I	I	NI	I	NI	NI	NI	I	I	NI	NI	No
Land Ownership (Private Lands)	ı	I	I	I	ı	ı	NI	I	ı	ı	NI	NI	ı	NI	I	Yes
Surface Water and Groundwater Resource Use	NI	NI	NI	NI	I	NI	NI	NI	NI	NI	NI	I	NI	NI	NI	No
Recreational and Commercial Use of Waterways	NI	I	I	NI	NI	NI	NI	NI	NI	ı	I	NI	NI	NI	NI	No
Transportation and Access	I	I	I	I	I	I	I	I	I	I	ı	I	I	I	I	Yes

Note: I = interaction, KI = key interaction, NI = no interaction



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19.4.3.1.1 Significance of Residual Cumulative Effects

Land uses within the RSA (i.e., mining, mineral exploration, quarrying, forestry, hunting, trapping, ranching and outdoor recreation, etc.) could be affected by the Project by disrupting access to or use of tenures. This will be caused by ongoing industrial activity within the RSA (e.g., mineral exploration and related activities, Endako Molybdenum mine, and forestry and logging activities), and anticipated future industrial activities (e.g., Nulki Hills Project, Fraser Lake Biomass Project, future mineral exploration and related activities, and logging activities). Logging activities would continue where economically feasible and unaffected by MPB. However, in the regional context, the non-anthropogenic MPB epidemic is the biggest contributor to land base disturbance, with over half (52%) of the forested land base identified as severely affected by the MPB infestation, 2% as moderately affected, and 7% as low. The summary of cumulative effects is in **Table 19.4.3-3**.

19.4.3.1.1.1 Recreation/Tourism Use

In the long-term future, it is expected that there will be an increase in the number of people engaging in non-consumptive recreation, adding to the demand for off-road areas, and potentially increasing the number of people seeking motorized vehicle and non-motorized access to and within the RSA. The creation of additional and improved access in the RSA could provide greater access for non-consumptive recreational use. Improved access will facilitate an increase in the intensity of ATV and/or snowmobile riding, camping, hiking, and/or wildlife viewing in the RSA. However, it is unknown how many non-consumptive recreation enthusiasts will act on an increase in access in the RSA resulting from industrial linear developments. Nevertheless, it is anticipated that the cumulative effect of improved access on outdoor recreation opportunities will be positive, moderate in magnitude, long-term, regional, and continuous, and predicted with high confidence. With increased access, there is the possibility of increased friction between people engaging in different recreational activities, particularly between those using off-road vehicles and those enjoying non-motorized outdoor pursuits. The level of increased friction between people engaging in different types of recreational activities is expected to be of low magnitude, long-term, infrequent, and regional. The magnitude of the Project's contribution to effects on general recreation is low.

The Proponent will enhance and coordinate access management via the TAMP and continued adherence to the terms and conditions of the Road Use Agreement. Ultimately, in the future, the proponent may take over from Canfor the responsibility for management and enforcement of the road use agreement prior to the start of construction. The proponent will coordinate with neighbouring industrial, government, and recreational stakeholders to further reduce the risk of harmful cumulative effects on non-consumptive outdoor recreation. The likelihood of the effect occurring is moderate and is stated with moderate confidence. The overall cumulative effect including that of the Project on non-consumptive outdoor activities is Not Significant (minor).



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Table 19.4.3-3: Summary of Significance of Cumulative Effects

Project Phase	NTLU Key Indicators	Context ¹	Magnitude	Geographic Extent	Duration	Reversibility	Frequency	Likelihood Determination	Level of Confidence for Likelihood	Significance Determination	Level of Confidence for Significance
C, O, D/C	Recreation/Tourism Use	Neutral	Low	Regional	Long-term	Yes	Intermittent	Moderate	High	Not Significant (minor)	Moderate
C, O, D/C	Mining Exploration and Mineral Tenures	Neutral	Low	Regional	Long-term	Yes	Continuous	Moderate	High	Not Significant (minor)	Moderate
C, O, D/C	Forestry and Timber Resource Use	Neutral	Low to Medium	Regional	Long-term	Yes	Continuous	Moderate	Moderate	Not Significant (minor)	Moderate
C, O, D/C	Hunting, Trapping, and Guide Outfitting	Neutral	Low	Regional	Long-term	Yes	Continuous	Moderate	Moderate	Not Significant (minor)	Moderate
C, O, D/C	Agriculture and Grazing	Neutral	Negligible to Low	Regional	Long-term	Yes	Continuous	Moderate	Moderate	Not Significant (negligible)	Moderate
C, O, D/C	Land Ownership (Private Lands)	Neutral	Low	Regional	Long-term	Yes	Continuous	High	High	Not Significant (minor)	High
C, O, D/C	Transportation and Access	Neutral	Low	Regional	Long-term	Yes	Continuous	Moderate	High	Not Significant (minor)	Moderate

Notes: 1 Method for the consideration of context is discussed in Section 4, Assessment Methodology.

C = construction; O = operations; D/C = decommissioning and closure



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19.4.3.1.1.2 Mining Exploration and Mineral Tenures

Regionally, if all tenures and activities were to reach their full extent of planned and approved development during the same timeframe, the total disturbance to the land base is expected to represent a low magnitude, negative, regional, long-term, continuous, and reversible effect. This is due to the fact that the contribution of development of future mineral is expected, but would not add significantly to the loss in the land base and that the Project's contribution to land base disturbance is low. The Proponent will communicate in a timely manner with applicable tenure holders in the Project area to coordinate activities and avoid active tenures. The likelihood of the effect occurring is moderate. Thus, the overall cumulative effect of the Project is Not Significant (minor).

19.4.3.1.1.3 Forestry and Timber Resource Use

Within the RSA, the cumulative, multiple effects of all industrial developments will be to reduce the harvestable timber land base, reduce the merchantable timber for forestry tenure holders, alter the sequence and timing of timber harvesting and processing (if the tenure holder is contracted by the Proponents to harvest and process timber from their respective Project footprints), and increase access to the remaining harvestable timber.

Industrial stakeholders within the RSA will reforest areas cleared for Project facilities following decommissioning, and/or progressively reclaim throughout the life of the Project, as applicable. Although forest productivity may improve after reclamation, the cumulative effect of the industrial footprint on the harvestable timber land base is estimated to be low in magnitude, negative, regional, long-term, continuous, and reversible. The increases in access routes associated with industrial development within the RSA may make it easier for forestry stakeholders to harvest a larger area of the timber resource in their forestry tenures within the RSA by lowering access road construction costs and making access less time consuming and safer. Despite the lack of available analytical results quantifying the relationship between decreased resource access time, road construction costs, and increased operational safety with an increase in linear access density for the forestry industry, based on professional judgment, it is predicted that the facilitation of forestry activities by increasing access is a low to moderate magnitude, positive, regional, long-term, continuous, and reversible effect. In the regional context, the Project's contribution to forestry is low. The residual effect on forestry is considered low. The likelihood of the effect occurring is moderate and is stated with moderate confidence. Thus, the overall cumulative effect on forestry is Not Significant (minor).

19.4.3.1.1.4 Hunting, Trapping, and Guide Outfitting

The cumulative effects on consumptive outdoor activities may include a decrease in the total area within the RSA available for use, an increase in access to the RSA, and the decline of and disruption to wildlife and furbearer species.

Consumptive outdoor recreation will be precluded at, and in the immediate vicinity of, all industrial facility areas within the RSA. However, the maximum amount of land lost for consumptive outdoor recreation activities in the RSA due to the industrial footprint (excluding cutblocks, recent burn, and MPB-affected land base) is expected to be low. Thus, this loss of harvestable land base for



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consumptive outdoor activities in the RSA is a low magnitude, negative, long-term, regional, continuous effect. Cumulatively, in the regional context, increased and improved access will facilitate consumptive outdoor activities. However, increased access could lead to conflicts between different resource users. Although these effects cannot be quantified, these negative effects are anticipated to be low in magnitude, regional, long-term, and continuous. The Project's contribution to these effects is low.

Additionally, correlations between varying levels of industrial and associated access development and variable population sizes among furbearer and big game species, and correlations between wildlife population sizes and hunting and trapping success rates, are not well known. However, industrial disturbances such as noise, human presence, and habitat loss may lead to a decline or dispersion in wildlife populations that are sensitive to disturbance, or that need large, continuous home ranges. This decline or dispersion in wildlife populations in the RSA may lead to decreased hunting and trapping success and associated revenues for both guide outfitters and trappers. The effect of decreasing wildlife populations on hunting and trapping success rates is expected to be low in magnitude, negative, regional, long-term, and continuous. The Project's contributions to effects on consumptive outdoor activities are low. The likelihood of the effect occurring is moderate and is stated with moderate confidence. The overall cumulative effect of the Project on consumptive outdoor activities is Not Significant (minor).

19.4.3.1.1.5 Agriculture and Grazing (including range use)

The Project's contribution to residual effects on range lands is low. There are no residual effects on agricultural lands as Project components are outside of agricultural lands. The cumulative effect on range lands and activities is expected to be of negligible to low magnitude, negative, regional, long-term, continuous, and reversible. The overall aesthetic cumulative effect of the Project on agriculture and range lands is Not Significant (negligible). This effect is moderately likely to occur and is stated with moderate confidence.

19.4.3.1.1.6 Land Ownership

The Project will generate disturbances related to noise and dust and disruptions to access that will potentially affect private land owners. These disturbance effects might interact cumulatively with the disturbance from existing Projects and other existing activities in the region. However, these existing and future projects and activities are interspersed throughout a relatively large region. The contribution of the Project is low. Regionally, cumulative effects on noise, dust and disruptions to access are estimated to be low in magnitude, negative, regional, long-term, continuous, and reversible. The likelihood of the effect occurring is high and is stated with high confidence. Therefore, the overall aesthetic cumulative effect of the Project is Not Significant (minor).

19.4.3.1.1.7 Transportation and Access

Land and resource uses are affected by a combination of increases in both population and access in the region. These effects are both positive and negative for a variety of land and resource uses and users as a result of the cumulative effect of industrial and associated access development in the RSA. The planned and baseline industrial developments within the RSA will contribute to access development. Utility and pipeline corridors and access roads open areas for both



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recreational and consumptive uses (e.g., ATV use, snowmobiling, non-motorized recreation, hunting, fishing, and trapping) and additional industrial uses (i.e., forestry, oil and gas, and aggregate exploration and extraction/harvesting).

Based on the network of roads within the RSA and the contributions of future developments to access, the magnitude of cumulative access development in the RSA is considered a low, regional, long-term, and continuous effect, and is stated with moderate confidence. The likelihood of the effect occurring is moderate. In the regional context, the Project's contribution to access effects is moderate. The overall cumulative effect of the Project is Not Significant (minor).

19.4.3.1.2 **Limitations**

This subsection presents assumptions and limitations relative to the assessment of Project effects and the assessment of cumulative effects.

Limitations for the land and resource use effects assessment are directly associated with the availability of representative and current land use information. Existing land and resource uses may not necessarily remain the same, as land uses and users may change over time. In addition, there is the limitation of the uncertainty of planned future Projects and activities, where proposed future Projects and activities may or not proceed, depending on various economic, regulatory, or other factors.

19.4.3.1.3 Conclusion

This assessment has addressed both Project cumulative on non-traditional land and resource uses and users and has considered Project effects throughout the Project life cycle. The majority of Project-specific land and resource use effects in all study areas will be low in magnitude, due to sound Project design and the implementation of appropriate mitigation measures, including compensation where applicable. The remaining Project-specific land and resource use effects will be negligible after mitigation.

The primary effect of clearing land for industrial use will be a reduction to the available land base for other land and resource uses. Progressively, throughout the Project and following decommissioning, the Proponent will revegetate and reclaim cleared areas to make them available for other land use activities. This will be carried out in accordance with the Reclamation and Closure Plan.

An increase in access creates both positive and negative effects on land and resource uses and users. It facilitates land use activities by opening new areas and reducing travel times to target areas. Conversely, new access increases use pressure on resources and the potential for conflict between users. The Proponent will implement the Transportation and Access Management Plan, adhere to the terms and conditions of the Canfor Road Use Agreement and may in the future take over prime responsibility for implementation of the road use agreement, and work with forestry and other stakeholders to address ongoing and current access issues. In cooperation with locally affected trappers, guide outfitters, farmers, ranchers, and private land holders, the Proponent will



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develop and implement mitigation measures, according to established industrial and provincial protocols and best practices.

Results of the cumulative effects on land and resource uses and users (i.e., recreation and tourism, forestry, mining exploration and mineral tenures, trapping and hunting, ranching, land ownership and access) were considered low. Therefore, all cumulative effects are deemed Not Significant (minor).

19.4.3.2 Current Land and Resource Use for Traditional Purposes

Potential cumulative effects on CLRUTP must be considered when the residual effect is determined to be other than Not Significant (negligible) and it overlaps, temporarily or spatially, with known or likely residual effects from past, present, or reasonably foreseeable projects within the established RSA. As with NTLRU, the potential cumulative interactions are numerous and both use-specific and group-specific. The CEA method used is consistent with other VCs (the same criteria and attributes are used) but the format for presentation is different to enable a clearer understanding of the effects.

There are seven indicators experiencing residual effects with ratings of "Not Significant (minor)" or "Not Significant (moderate)" that will be carried forward in the CEA (**Table 19.4.3-4** as specified in the methodology described in **Section 4.3.6** of the Application.

There is one indicator for UFN (i.e. Other Cultural and Traditional Uses of the Land (trail at mine site and CMTs) which has determined to be Not Significant (minor). This indicator has a geographic extent is limited to the mine site and doesn't have the potential to interact with other projects or activities, therefore it will not be carried into the cumulative effects assessment.

Table 19.4.3-4: Residual Effects on CLRUTP Carried Forward for Cumulative Effects
Assessment

Indicator Experiencing Residual Effect	Significance Rating
LDN Hunting	Not Significant (moderate)
LDN Trapping (TR0512T014)	Not Significant (minor)
LDN Fishing	Not Significant (minor)
LDN Plant harvesting	Not Significant (minor)
UFN Hunting	Not Significant (moderate)
UFN Trapping	Not Significant (minor)
UFN Fishing	Not Significant (minor)
UFN Plant harvesting	Not Significant (minor)

19.4.3.2.1 Potential Cumulative Effects

To have potential cumulative effects, the five residual effects (**Figure 19.4.3-1**) have to interact with other activities in the RSA, spatially or temporally. Activities that could potentially interact with



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the above residual effects on the LDN or UFN traditional territories, either spatially or temporally include:

- Mineral exploration;
- Forestry-related activities (cut blocks, woodlots);
- Agriculture and grazing;
- Transportation and access;
- Non-traditional hunting, fishing, trapping and guide outfitting; and
- Other recreational activities.

The only existing mining operation in the CLRUTP RSA is at Endako, but it is not located within LDN nor UFN traditional territories and its operations do not affect their traditional territories. The Nulki Hills Wind Project is also located outside of LDN and UFN traditional territory and therefore it is not considered in the assessment of cumulative effects. Other projects, such as the proposed gas pipeline projects, do not intersect with the LDN or UFN traditional territories or areas where the current traditional land and resource uses (hunting, trapping, fishing and plant harvesting) are conducted. Therefore, these projects were not included in this CEA.

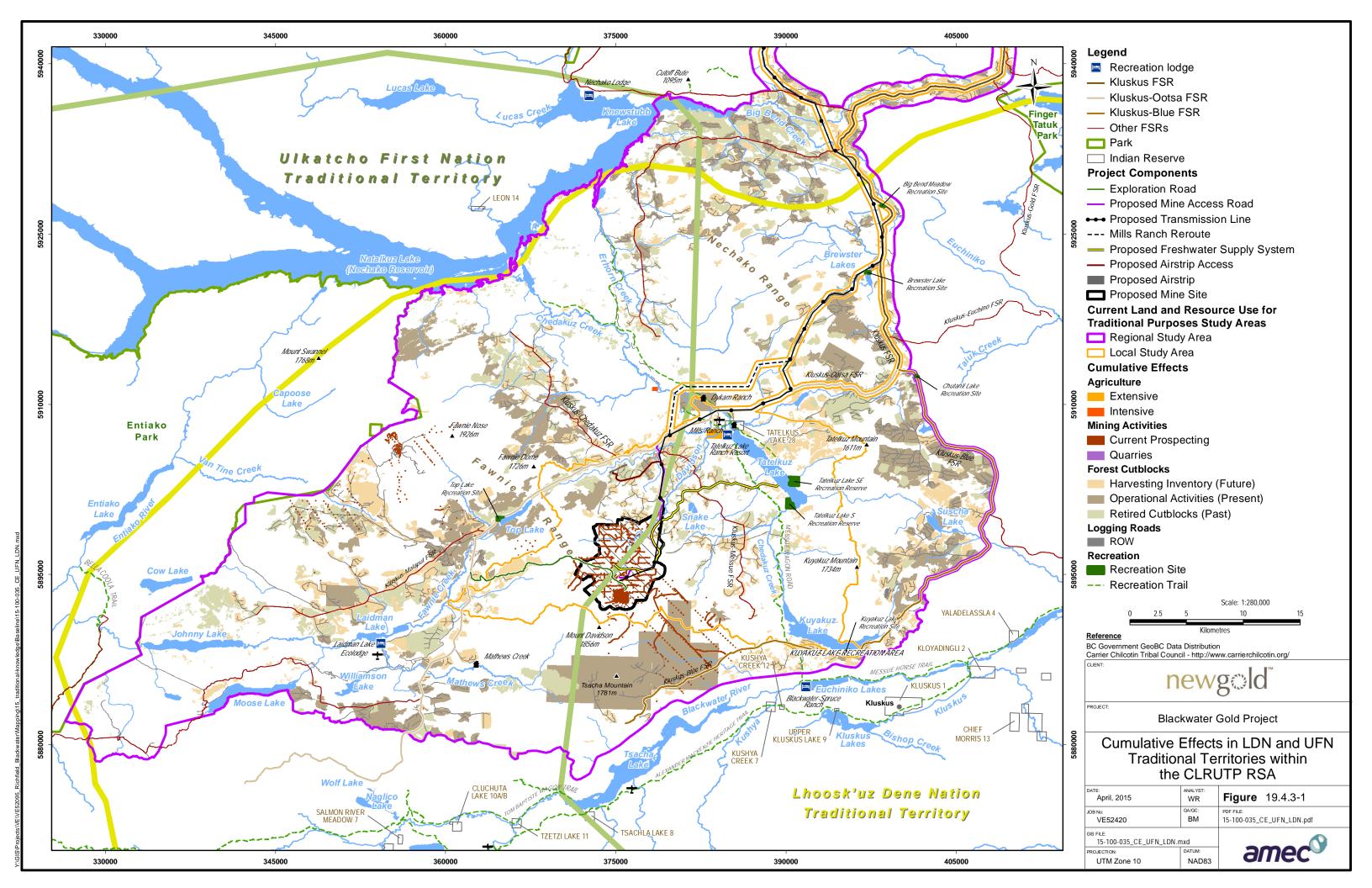
Figure 19.4.3-2 illustrates past, present and future reasonable foreseeable projects and activities within the portions of LDN and UFN traditional territories overlapping with the CLRUTP RSA. The assessment of cumulative effects is largely based on the estimated habitat availability losses for plants and wildlife, derived from the footprint of projects and activities considered for the assessment. Specific information regarding effects of other projects or activities on access, sensorial disturbances or disruption of aquatic habitat is not available for use in the cumulative effects.

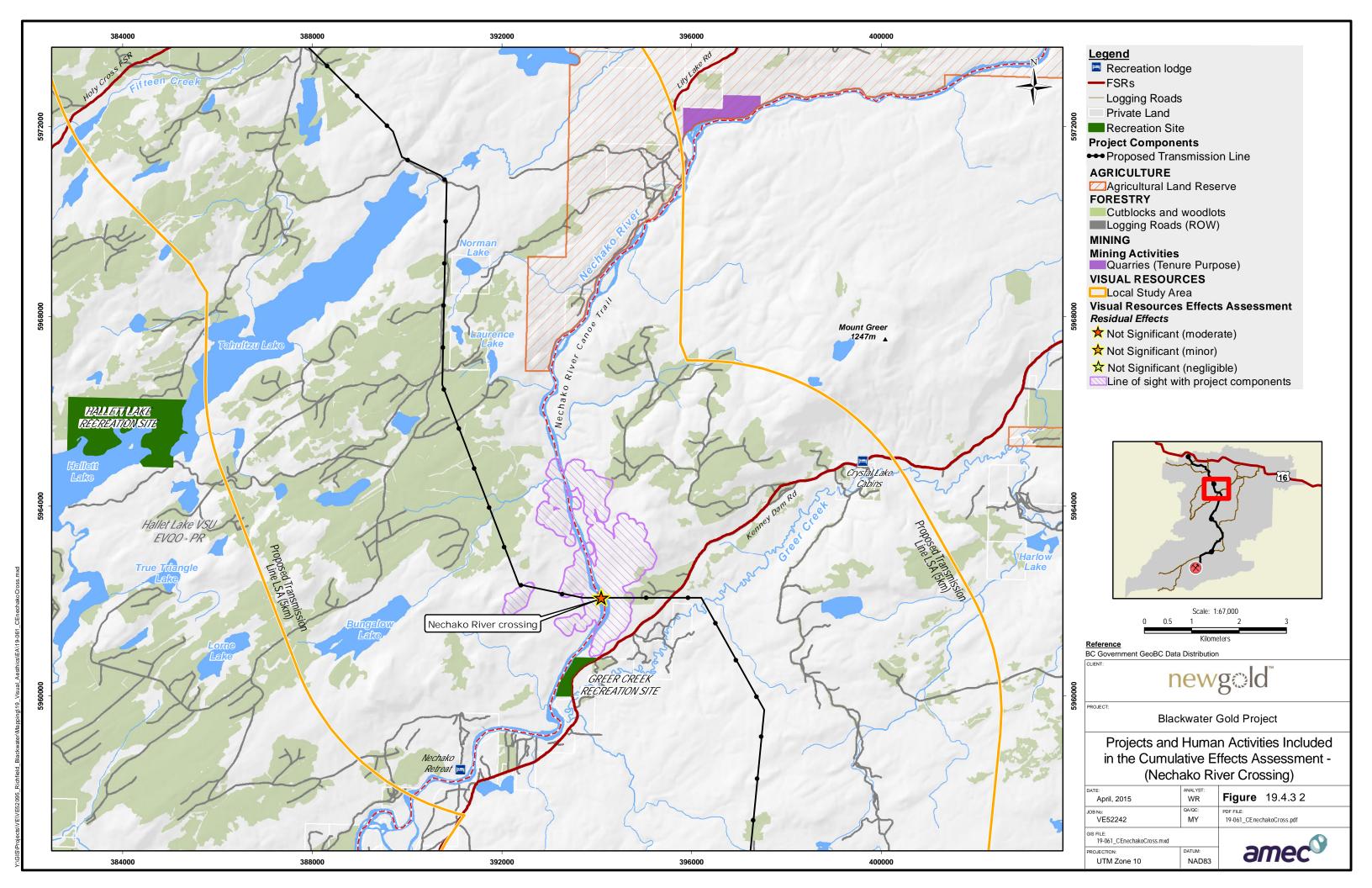
Mineral exploration activities, forestry activities, agriculture, and grazing, transportation and access, non-traditional hunting, trapping, guide outfitting and other recreation uses contribute to cumulative activities and land disturbance that negatively affects wildlife abundance and distribution and therefore hunting and trapping success in the RSA. These activities also affect the quality of fish habitat and the abundance of plants used for traditional purposes. The majority of the disturbance within the overall RSA is caused by forestry activities accounting for approximately 94% of the total disturbance in the RSA.

19.4.3.2.1.1 Mitigation

Cumulative effects mitigation requires the input and participation of a range of industry parties (in this case forestry, mining, energy, etc.). The Proponent remains committed to supporting regional initiatives which address cumulative effects such as those related to caribou. Other mitigation developed by the Proponent will alleviate future cumulative effects on hunting, trapping and traditional plants gathering including mitigation designed for fish habitat compensation and revegetation and reclamation activities. Forestry and mineral exploration companies are also required to implement reclamation and revegetation measures once they complete activities in a specific area.







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19.4.3.2.1.2 Residual Effects and Determination of Significance

This section presents the determination of significance for cumulative effects in hunting, trapping and fishing for LDN and hunting for UFN.

19.4.3.2.1.2.1 Lhoosk'uz Dene Nation

Hunting and Trapping

Approximately 70,000 ha of the portion of the RSA located within LDN traditional territory is or will be affected by past, present and future projects and activities. **Table 19.4.3-5** presents the details of the overlaps of past, present and future projects and activities within the RSA portion located in LDN traditional territory. As indicated, forestry is a key driver of cumulative effects in the area.

In addition to the effects of other projects and activities, the proposed Project will affect the availability of 4,777 ha of land in LDN traditional territory, for an estimated total of approximately 75,000 ha experiencing cumulative effects. In summary, approximately 28% of LDN's traditional territory overlapping the RSA for CULRTP are or will be experiencing cumulative effects.

There are ongoing mineral exploration activities occurring in the northern portion of the Fawnie Range and Mount Davidson as well as southeast of the proposed mine site on trapline TR0512T014 and Keyoh held by the Jimmie family (LDN members). These areas are currently used for hunting and trapping. It is therefore reasonable to expect that these activities will have a negative cumulative effect on current traditional hunting and trapping by members of the LDN in these areas. The Jimmie family Keyoh is an exclusive traditional use area that sustains the family under the direction of the most senior family male (detso). Others who wished to use the Keyoh had to seek permission from, or be invited by the detso. Similarly, member of the Jimmie family cannot use other family's territories without permission from their detsos.

The cumulative effect on hunting is significant mainly because of the magnitude (28%) of the estimated disturbance within LDN's territory overlapping the RSA. This cumulative effect has a chronic duration (+35 years), regional extent, it is continuous but reversible with the implementation of mitigation measures such as revegetation. The context of the cumulative is high given the already existing disturbance.

A very small portion of approximately 8.1 ha (0.07%) of Trapline TR0512T014 is overlapped by the proposed mine site, but there are approximately 5,284 (48%) hectares (of past, present and reasonable foreseeable disturbances within the trapline territory by other projects and activities. In summary, close to 50% of the Trapline surface is or will be experiencing cumulative effects. **Table 19.4.3-5** presents the details of the overlaps of past, present and future projects and activities within Trapline TR0512T014.

The cumulative effect on trapping at TR0512T014 is significant mainly because of the magnitude (50%) of the estimated disturbance. This cumulative effect has a chronic duration (+35 years), local extent (restricted to trapline), it is continuous but reversible with the implementation of mitigation measures such as revegetation. The context of the cumulative is high given the already existing disturbance.



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Table 19.4.3-5: Past, Present and Future Projects and Activities in LDN Traditional Territory Overlapping RSA

	Spatial Overlap with	Temporal Overlap with	Amount of Spatial Overlap			
Project/Activity	Terrestrial RSA (Yes/No)	Terrestrial RSA (Yes/No)	(ha)	Past	Present	Future
Mining and	Yes	Yes	241		Current Prospecting	
exploration					222	
					Active Quarries	Pending Quarries
					19	0
Nulki Hills Wind	No	No	0			Proposed Infrastructure
Project						0
Forestry (cutblocks	Yes	Yes	66,000	Retired Cutblocks	Active Cutblocks and	Full harvesting inventory and
and woodlots) -				and Woodlots	Woodlots	Pending Woodlots
past, present & future				15,875	29,248	20,876
Forestry roads	Yes	Yes	2,457		Current Roads	
					2,457	
Agriculture and	Yes	Yes	144		Present Extensive and	Pending Extensive
grazing					Intensive Agriculture Tenures	Agriculture Tenures
					144	0
Other transportation	Yes	Yes	704		Current Main Roads	
and access roads (excl forestry)					704	
Non-traditional	Yes	Yes	n/a ⁽²⁾		Active Traplines	
hunting, trapping					245,650	
and guide outfitting					Active Guide Outfitter Areas	
					251,061	
Other recreation	Yes	Yes	471.9		Active Recreation Sites	Retired Recreation Sites
uses					472	0
					Active Recreation Trails	Retired Recreation Trails
					(km)	(km)
					46	
Total ⁽³⁾			70,017	15,875	33,266	20,876

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Table 19.4.3-6: Past, Present and Future Projects and Activities in Trapline TR0512T014

	Spatial Overlap with	Temporal Overlap with	Amount of Spatial Overlap			
Project/Activity	Terrestrial RSA (Yes/No)	Terrestrial RSA (Yes/No)	(ha)	Past	Present	Future
Mining and mineral	Yes	Yes	26		Current Prospecting	
exploration					26	
					Active Quarries	Pending Quarries
					0	0
Nulki Hills Wind	No	No	0			Proposed Infrastructure
Project						0
Forestry (cutblocks and woodlots) - past,	Yes	Yes	5,160	Retired Cutblocks and Woodlots	Active Cutblocks and Woodlots	Full harvesting inventory and Pending Woodlots
present & future				0	4,978	182
Forestry roads	Yes	Yes	79		Current Roads	
					79	
Agriculture and grazing	Yes	Yes	0	Present Extensive Agriculture Tenures		Pending Extensive Agriculture Tenures
				0		0
Other transportation	Yes	Yes	19		Current Main Roads	
and access roads (excl forestry)					19	
Non-traditional	Yes	Yes	n/a ⁽²⁾		Active Traplines	
hunting, trapping and					11,076	
guide outfitting					Active Guide Outfitter	
					Areas	
					11,076	
Other recreation uses	No	No	0		Active Recreation Sites	Retired Recreation Sites
					0	0
					Active Recreation Trails (km)	Retired Recreation Trails (km)
					0	0
Total ⁽³⁾			5,284		0	0

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Fishing

Section 5.3.8.5 of the Application provides a detailed overview of interactions between fish and fish habitat, and mining, exploration, oil and gas development, forestry related activities, agriculture and grazing, transportation and access, non-traditional hunting, trapping and guide outfitting, recreational activities, and Aboriginal land use. It was concluded that none of these activities would contribute to cumulative effects on fish and fish habitat and a CEA was not carried forward. Given that these same activities could interact with fishing for traditional purposes, it is concluded that cumulative effects on fishing for traditional purposes are also not expected.

Plant Harvesting

In **Section 5.4.5** of the Application the cumulative spatial overlap (ecosystem loss) of other past, current, and future foreseeable projects on ecosystem composition (which combined ecosystem distribution, riparian and traditional use plants indicators—berries) was assessed as Not Significant (moderate). Forestry activities were considered a main contributor to this ecosystem loss, as was the effect of the mountain pine beetle. The cumulative ground disturbance from projects and activities listed in **Figure 19.4.3-1** within the CLRUTP RSA, which could include a wide range of plants used for traditional purposes is 3,921 ha.

In addition, to the loss caused by the Project there is an estimated loss of availability to approximately 70,000 ha within the LDN's traditional territory overlapping the RSA, forestry being the main driver of these cumulative effects.

There are areas that are preferred, or more intensely used for plant harvesting, around Tatelkuz Lake, and along the Messue Wagon Trail, which will not be drastically impacted by land clearing for Project but that are or will be experiencing cumulative effects from other activities, mainly forestry. These areas are also being used for guide outfitting, grazing, some recreation use at Tatelkuz Lake and mineral exploration.

The cumulative effect on plant harvesting is Not Significant (moderate) mainly because of the magnitude (28%) of the estimated disturbance. This cumulative effect has a chronic duration (+35 years), regional extent because the effects are spread in the RSA, it is continuous but reversible with the implementation of mitigation measures such as revegetation. The context of the cumulative is high given the already existing disturbance.

19.4.3.2.1.2.2 Ulkatcho First Nation

Hunting and Trapping

Hunting and trapping for traditional purposes by members of the UFN is also potentially affected through the cumulative interactions of the Project, other future foreseeable projects as noted above. The UFN identify current hunting and trapping activities occur within and around the mine site (which includes Mount Davidson), along the transmission line ROW (and Mills Ranch Reroute), near Tatelkuz Lake, Kuyakuz Lake and Chedakuz Creek. These areas are affected



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(through land disturbance) cumulatively by current exploration activities, forestry activities and associated logging roads, agriculture and grazing, transportation and access, non-traditional hunting, trapping, guide outfitting and other recreation uses. It is therefore reasonable to expect that these activities will have a negative cumulative effect on current traditional hunting by members of the UFN in these areas. The cumulative effect is important to the UFN. They indicate in the TLUS that:

"the proposed Blackwater project tenure is within prime caribou and moose habitat and an important caribou migration corridor. The UFN people are very concerned as to how drilling noise, vibration and habitat disturbances resulting from project development and operation phases and the construction of associated work sites will impact the caribou and moose habitat, migration routes and food sources" (TLUS).

Approximately 39,000 ha of the portion of the RSA located within UFN traditional territory is or will be affected by past, present and future projects and activities. In addition, the proposed Project will affect 3,232 ha, for an estimated total over 42,000 ha (27% of RSA located in UFN's traditional territory) experiencing cumulative effects. **Table 19.4.3-7** presents the details of the overlaps of past, present and future projects and activities within the RSA portion located in UFN traditional territory. As indicated, forestry is a key driver of cumulative effects in the area.



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Table 19.4.3-7: Past, Present and Future Projects and Activities in in UFN Traditional Territory Overlapping RSA

	Spatial Overlap with	Temporal Overlap with	Amount of Spatial Overlap			
Duois at/A ativity	Terrestrial RSA	Terrestrial RSA	(ha)	Past	Present	Future
Project/Activity	(Yes/No) Yes	(Yes/No) Yes	(ha) 99	Past		Future
Mining and exploration	res	res	99		Current Prospecting 97	
					Active Quarries	Pending Quarries
			_		2	0
Nulki Hills Wind Project	No	No	0			Proposed
						Infrastructure
						0
Forestry (cutblocks and	Yes	Yes	36,699	Retired Cutblocks and	Active Cutblocks and	Full harvesting
woodlots) - past, present & future				Woodlots	Woodlots	inventory and Pending Woodlots
				11,376	13,502	11,821
Forestry roads	Yes	Yes	1,945		Current Roads	
					1,945	
Agriculture and grazing	Yes	Yes	15		Present Intensive	Pending Extensive
					Agriculture Tenures	Agriculture Tenures
					15	0
Other transportation and	Yes	Yes	392		Current Main Roads	
access roads (excl forestry)					392	
Non-traditional hunting,	Yes	Yes	n/a ⁽²⁾		Traplines	
trapping and guide					148,688	
outfitting					Guide Outfitter Areas	
					152,642	
Other recreation uses	Yes	Yes	266		Recreation Sites	Retired Recreation Sites
					266	0
					Recreation Trails (km)	Retired Recreation Trails (km)
					10	, ,
Total ⁽³⁾			39,416	11,376	16,219	11,821

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The cumulative effects on hunting and trapping are medium in magnitude since the cumulative Projects/activities overlaps several areas used for current traditional hunting (27% of UFN's traditional territory in RSA). The geographic extent of the cumulative effects is regional since the overlapping activities are spread over the RSA. The cumulative effect occurs in the chronic until re-vegetation measures are completed and is reversible. The frequency of the effect is continuous while these activities are underway although reclamation of exploration and forestry activities occurs regularly and may reduce these effects to some extent over time. The cumulative effects on hunting and trapping are likely (high) and considered Not Significant (moderate). The confidence in this rating is moderate.

Fishing

Section 5.3.8.5 of the Application provides a detailed overview of interactions between fish and fish habitat, and mining, exploration, oil and gas development, forestry related activities, agriculture and grazing, transportation and access, non-traditional hunting, trapping and guide outfitting, recreational activities, and Aboriginal land use. It was concluded that none of these activities would contribute to cumulative effects on fish and fish habitat and a CEA was not carried forward. Given that these same activities could interact with fishing for traditional purposes, it is concluded that cumulative effects on fishing for traditional purposes are also not expected.

Plant Harvesting

In **Section 5.4.5** of the Application the cumulative spatial overlap (ecosystem loss) of other past, current, and future foreseeable projects on ecosystem composition (which combined ecosystem distribution, riparian and traditional use plants indicators—berries) was assessed as Not Significant (moderate). Forestry activities were considered a main contributor to this ecosystem loss, as was the effect of the mountain pine beetle. The cumulative ground disturbance from projects and activities listed in **Figure 19.4.3-1** within the CLRUTP RSA, which could include a wide range of plants used for traditional purposes is 2,732 ha.

In addition, to the loss caused by the Project there is a loss of availability to approximately 39,000 ha within the RSA and UFN's traditional territory, forestry being the main driver of these cumulative effects.

The cumulative effect on plant harvesting is Not Significant (moderate) mainly because of the magnitude (27%) of the estimated disturbance. This cumulative effect has a chronic duration (+35 years), regional extent and the effects are spread in the RSA, it is continuous but reversible with the implementation of mitigation measures such as re-vegetation. The context of the cumulative is high given the already existing disturbance.

19.4.3.2.2 Summary of Cumulative Effects

Table 19.4.3-8 presents a summary of the determination of significance for cumulative effects occurring in LDN and UFN traditional territories.



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Table 19.4.3-8: Summary of Cumulative Effects on Current Land and Resource Use for Traditional Purposes

Project Phase	Key Indicators	Context	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood	Confidence in Likelihood Determination	Residual Effect Significance	Confidence in Significance Determination
Lhoosk'ı	uz Dene Nation										
C, O, CL, PC	Hunting	High	Moderate	Regional	Chronic	Continuous	Reversible	High	Moderate	Moderate	Moderate
C, O, CL, PC	Trapping (TR0512T014)	High	High	Local	Chronic	Continuous	Reversible	High	Moderate	Significant	Moderate
C, O, CL, PC	Plant Gathering	High	Moderate	Regional	Chronic	Continuous	Reversible	High	Moderate	Moderate	Moderate
Ulkatcho	First Nation										
C, O, CL, PC	Hunting	High	Moderate	Regional	Chronic	Continuous	Reversible	High	Moderate	Moderate	Moderate
C, O, CL, PC	Trapping	High	Moderate	Regional	Chronic	Continuous	Reversible	High	Moderate	Moderate	Moderate
C, O, CL, PC	Plant Gathering	High	Moderate	Regional	Chronic	Continuous	Reversible	High	Moderate	Moderate	Moderate

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19.4.3.2.3 **Limitations**

There are a number of limitations which should be considered. These include:

- Differing levels of TK/TLU data for each Aboriginal group. The depth of information also
 reflects the availability of relevant data from secondary sources, and the willingness of
 Aboriginal groups to share potentially sensitive information with the Proponent and the
 public. Two Aboriginal groups provided TK/TLU data which was incorporated into the
 document. However, three Aboriginal groups were in varying stages of completion
 regarding the TK/TLU studies and as a result the information was not included in the
 assessment;
- Comprehensiveness of primary data. Some TK/TLU was obtained through interviews
 with key Aboriginal representatives, knowledge holders, and through consultation. This
 form of data collection presents a limitation with respect to its comprehensiveness and
 whether discussions can be attributed to other members of the Aboriginal group;
- Distinguishing between historic and current use. In the available TK/TLU studies provided, it is difficult to distinguish between historic and current uses;
- Results from bio-physical components are limited to study areas that do not necessarily take into account current use of land and resources for traditional purposes by persons; and
- For the CEA, the footprints of other projects and activities are largely based on secondary available information.

19.4.3.2.4 Conclusion

This subsection provides a conclusion regarding the significance of residual effects and cumulative effects if applicable.

Results of the assessments were completed for each Aboriginal group that may experience Project effects. The Proponent continues to engage with potentially affected Aboriginal groups, and is in discussions about completing studies to provide traditional land and resource use information. Project-related effects on CLRUTP will be considered as new information becomes available.

The significance of effects of Project-related disturbances and activities on the CLRUTP VC was assessed after the application of mitigation measures. Effects were considered for the following indicators:

- Hunting;
- Trapping;
- Fishing;
- Plant Gathering; and
- Other Cultural Traditional Uses of the Land, including trails and travel routes, and other cultural features.



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No significant residual effects were identified.

Potential cumulative effects on CLRUTP were considered where adverse Project residual effects on the VC indicators overlap temporally or spatially with known or likely residual effects from past, present, or reasonably foreseeable projects or activities within the established RSA. It is noted that forestry is the main activity contributing cumulative effects in the RSA. Cumulative effects on LDN hunting and plant gathering were identified, although considered Not Significant (moderate). Cumulative effects on trapping in TR0512T014 were considered significant given the potential for 50% of that trapline to be affected by forestry. Cumulative effects on UFN hunting and plant gathering were identified, but considered Not Significant (moderate). Cumulative effects on LDN or UFN fishing are not expected.

19.4.3.3 Visual Resources

This subsection will determines the need for assessing cumulative effects and identifies and assesses potential cumulative effects.

A cumulative effect occurs if a residual effect of the Project, with a higher significance determination than Not Significant (negligible), overlaps spatially with known or likely residual effects of one or more current or future projects or human activities identified in the Project Inclusion List.

Forestry activities generate the most effects on visual resources. Forestry activities account for approximately 95% of the spatial overlap with visual resources within the RSA. For consideration of cumulative effects, this assessment includes retired, operational, and planned cut blocks connected by main FSRs and logging roads throughout the Visual Resources RSAs.

One operational mine (i.e., Endako Molybdenum) falls within the transmission line RSA. Prospecting activities are taking place in various mineral tenures in the Fawnie Range, within the mine site RSA. Agricultural activities occur in the Nechako Agricultural Land Reserve decreasing in density to the south. **Table 19.4.3-9** summarizes the spatial overlap with the Visual Resources RSAs:

Table 19.4.3-9: Spatial Overlap by Project / Activity in the Visual Resources RSAs

Project	Spatial Overlap with Visual Resources RSAs	Amount of Overlap (ha)
Agricultural activities	Yes	3,214
Mining activities	Yes	1,978 ^(a)
Forestry activities	Yes	89,626
Forestry roads	Yes	3,729
Total		103,001

Note: ha = hectares

(a) Current prospecting = 205 ha, Quarries = 452 ha, Active Mining = 1,978 ha



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19.4.3.3.1 Interactions between the Visual Resources VC and other Past, Present, or Future Projects/Activities

A total of 2,050 hectares (ha) of other projects and human activities overlap spatially with the residual effects of the Project. Forestry related impacts accounts for approximately 92% of the spatial overlap with visual resources (**Table 19.4.3-9**). Cumulative effects were evaluated for residual effects along the transmission line route at the Stellako River, Cheslatta Trail, and Nechako River crossing points, and Brewster Lake.

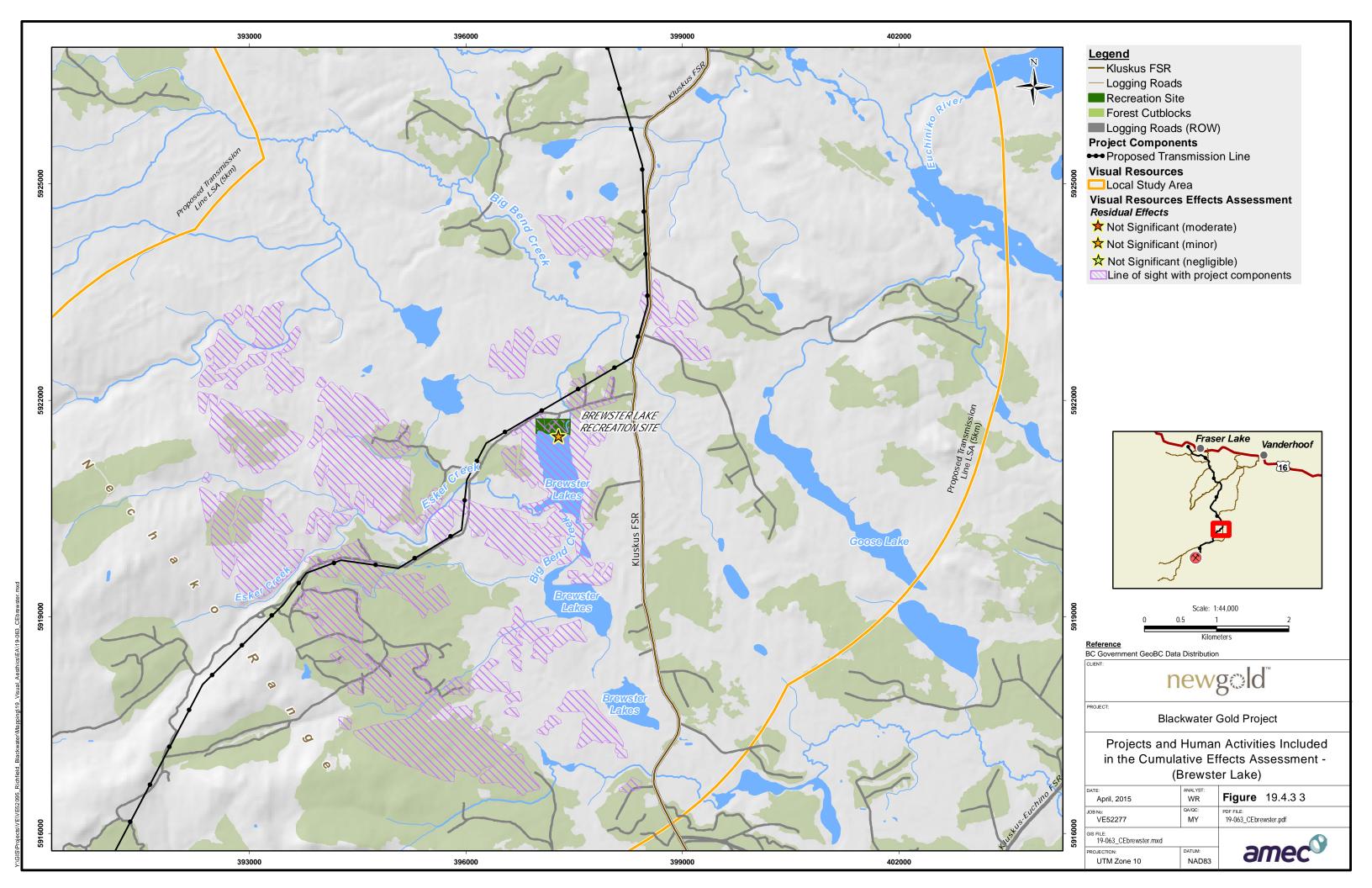
Cumulative effects were evaluated within the mine site at three locations along the east bank of Tatelkuz Lake **Table 19.4.3-10** and **Figure 19.4.3-2** to **Figure 19.4.3-6**.

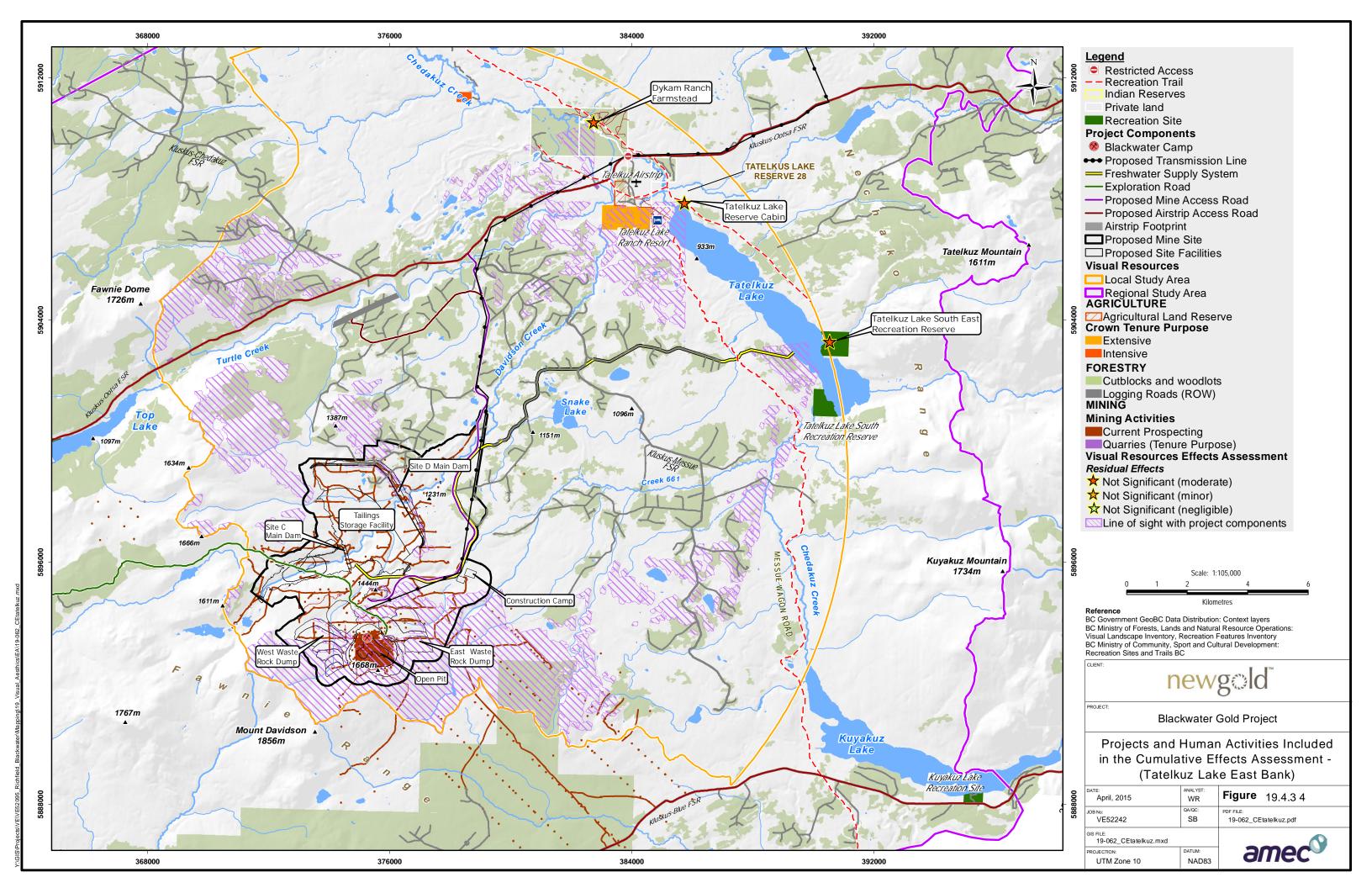
Table 19.4.3-10: Spatial Overlap by Project/Activity for Residual Effects Higher than Not Significant (Negligible)

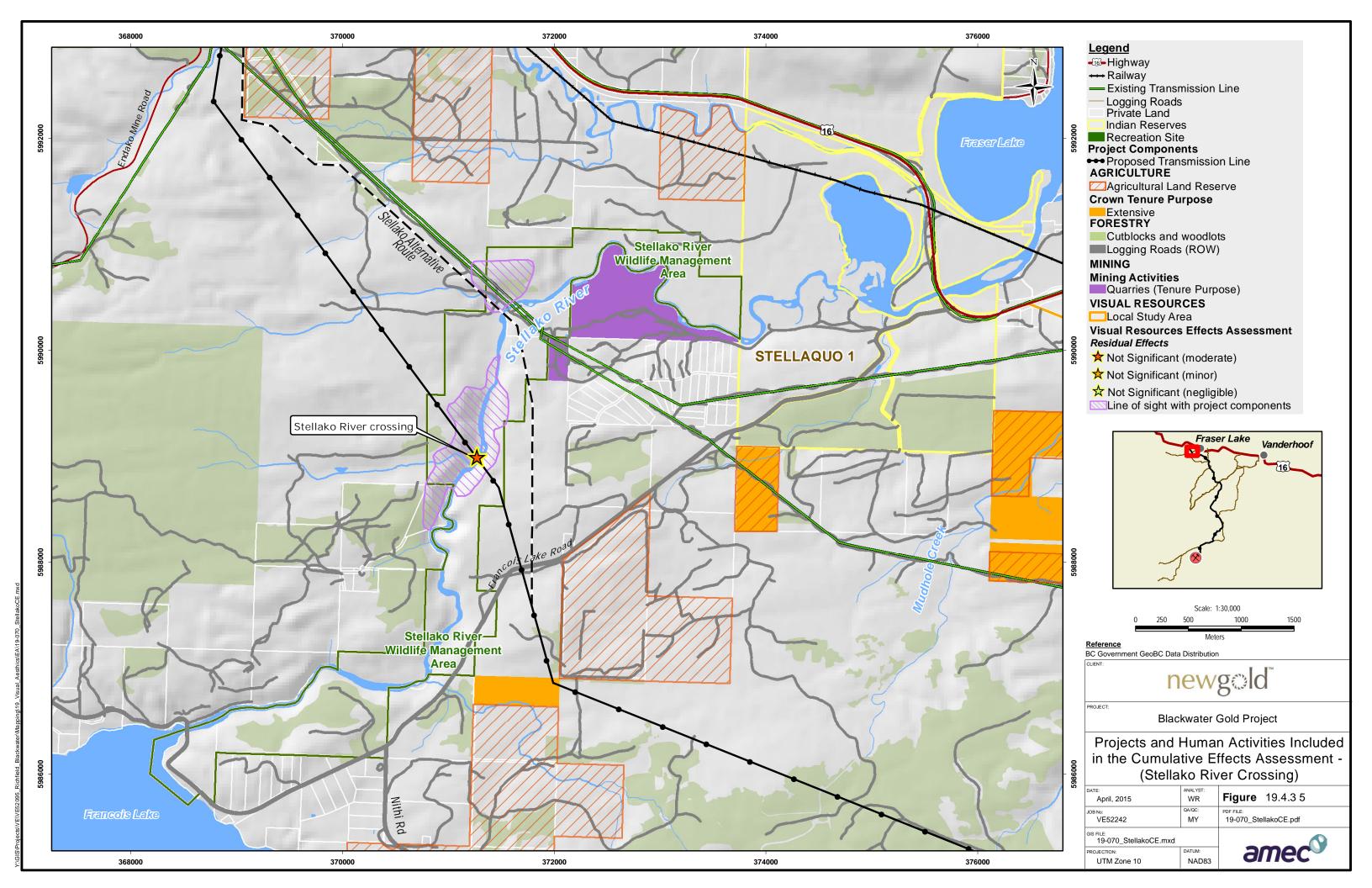
Evaluation Site	Sensitive Receptor	Residual Effect	Agriculture	Forestry	Mining	Total Overlap (ha)
1. Stellako River	Stellako River Crossing Point	Not Significant (moderate)	0	65	0	65
3. Cheslatta Trail	Cheslatta Trail Crossing Point	Not Significant (minor)	0	49	0	49
5. Nechako River Valley	Nechako River Crossing Point	Not Significant (moderate)	0	10	0	10
7. Brewster Lake	Brewster Lake Recreation Site	Not Significant (minor)	0	493	0	493
9. Tatelkuz Lake	Dykam Ranch; Tatelkuz Lake IR 28; Tatelkuz Lake Southeast Recreation Reserve	Not Significant (moderate)	69	1,288	76	1,433
Total						2,050

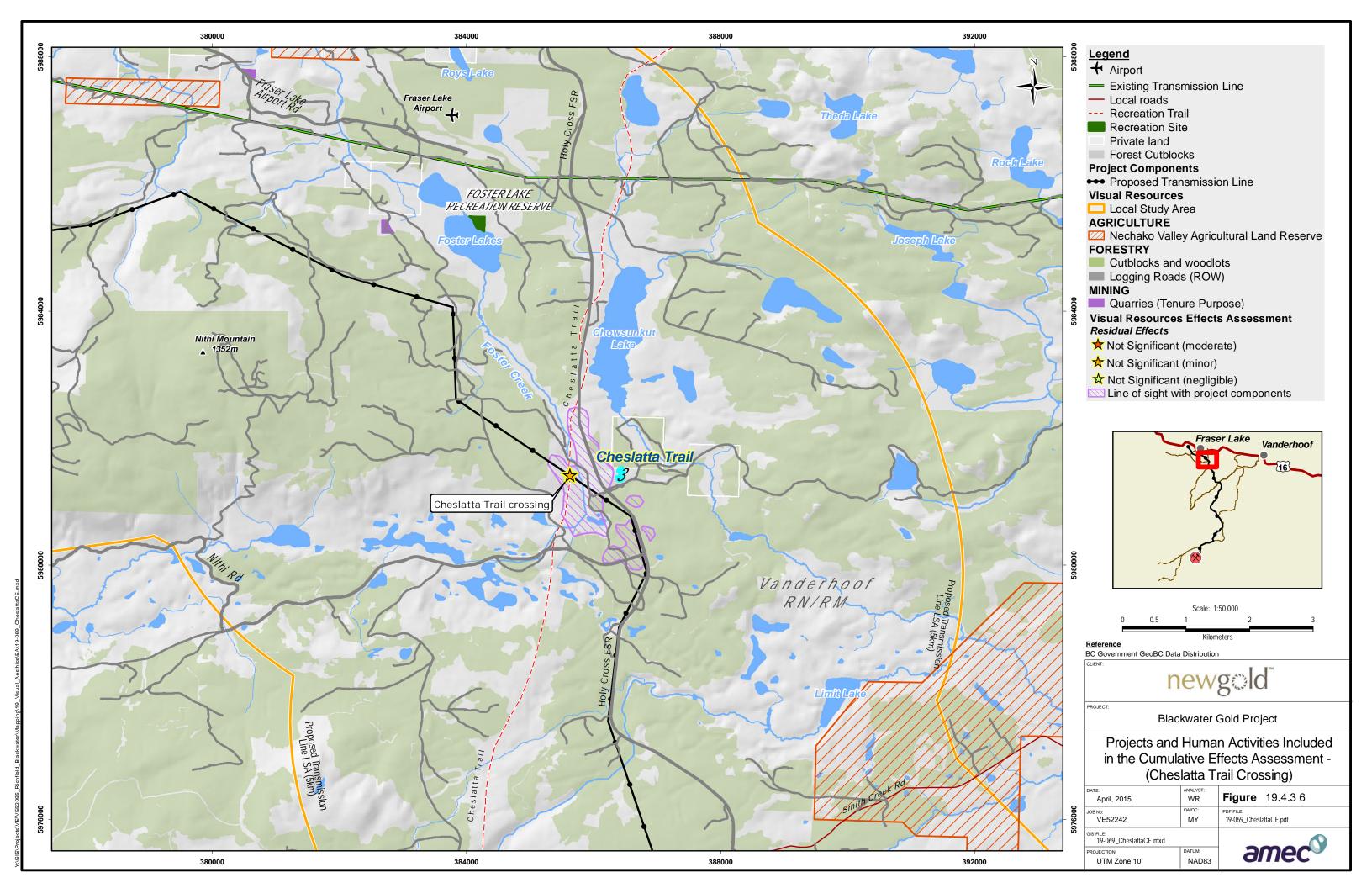
Note: ha = hectares











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19.4.3.3.2 Mitigation Measures and Potential Residual Cumulative Effects

There has been extensive forestry harvesting in the region since the MPB outbreak. The primary means to mitigate future forestry related impacts will be by continuing to follow forest harvest guidelines, including insect and disease management and reforestation.

With respect to agriculture, there is an overlap from the Tatelkus Lake IR 28 viewpoint of the Mills Ranch. The Tatelkuz Lake evaluation site was brought forward to Cumulative Effects Assessment because it was determined that the residual effect on visual resources was rated Not Significant (moderate). The Project Visual Resource Assessment was undertaken in the context of the presence of the Mills Ranch within the viewshed. As such, no additional cumulative visual effect is expected and no mitigation is proposed or required.

Current and future mining activities primarily focus on exploratory drilling and supporting access infrastructure concentrated within the Davidson Creek basin. These mining activities may be visible from the Tatelkuz Lake evaluation sites. However, they are highly localized disturbance sources located in excess of 15 km from any of the viewpoints. As such, visibility of these activities from the three viewpoints along the east bank of Tatelkuz Lake is considered to be obscured and no mitigation is proposed.

19.4.3.3.3 Significance of Potential Residual Cumulative Effects

The interaction between residual effects and other human interactions at the Stellako River Crossing comprises forestry activities. This interaction occurs with cut blocks and logging roads over 65 ha (Cut blocks - Future 64 ha, Logging Roads: 1 ha) with two forest cut blocks on the west bank of the river. Magnitude is Low given the small size of the overlap with a Local geographic extent and intermittent frequency. The effects are reversible when the transmission line is removed. When Project effects are considered, the cumulative significance determination is Not Significant (minor).

The interaction between residual effects and other human interactions at the Cheslatta Trail Crossing comprises forestry activities. This interaction occurs with cut blocks and logging roads over 49 ha (Cut blocks: Present 41 ha; Logging Roads: 8 ha) with forest cut blocks east of the trail. Magnitude is Low given the small size of the overlap with a Local geographic extent and intermittent frequency. The effects are reversible when the transmission line is removed. When Project effects are considered, the cumulative significance determination is Not Significant (minor).

The interaction between residual effects and other human interactions at the Nechako River Crossing comprises forestry activities. This interaction occurs over 10 ha (Cut blocks: Future 3 ha; Logging Roads: 7 ha) with two forest cut blocks on the east bank of the river. Magnitude is Low given the small size of the overlap with a Local geographic extent and intermittent frequency. The effects are reversible when the transmission line is removed. When Project effects are considered, the cumulative significance determination is Not Significant (negligible).

The interaction between residual effects and other human interactions at the Brewster Lake Recreation Site is also with forestry activities. This interaction occurs over 493 ha (Cutblocks: Past



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13 ha, Present 381 ha, Future 86 ha; and Logging Roads: 13 ha) with various forest cut blocks surrounding the site. This interaction occurs mostly at a distance of greater than 2 km along the slopes of the Nechako Range. Magnitude is therefore, Low with a Local geographic extent, as the cumulative effects are visible but distant. When Project effects are considered, the cumulative significance determination is Not Significant (minor).

The interaction between residual effects and other human interactions from sensitive receptors along the east bank of Tatelkuz Lake is with agriculture, forestry, and mining activities. This interaction comprises approximately 1,433 ha (Cutblocks: Past 159 ha, Present 671 ha, Future 421 ha; and Logging Roads: 37 ha), with numerous forest cut blocks within the Davidson Creek basin, one extensive agriculture tenure (Mills Ranch), and the footprint of prospecting drill holes and tracks along the slopes of the Fawnie Range.

Viewsheds for Dykam Ranch, Tatelkus Lake IR 28 and the Tatelkuz Lake South East Recreation Reserves sites are comparable due to their position on the west slopes of the Nechako Range, facing the east slopes of the Fawnie Range. The most visually prominent components of the mine site (open pit, waste rock dumps) will be visible, adding to the current disturbance within the viewsheds of the three sites. However, disturbance is incremental to current activities that are closer to the viewpoint. Although the visible extent of the mine site is relatively large and prominent due to elevation, it is distant at approximately 15 km.

Magnitude is Medium due to the facilities being visible but distant. Geographic extent is Local as effects are within the Mine Site LSA. Duration, Frequency, Reversibility, and Certainty are similar to the ratings as determined by the Residual Effects Assessment. When Project effects are considered, the cumulative significance determination is Not Significant (moderate).

The summary of cumulative effects is presented in **Table 19.4.3-11**.

19.4.3.3.4 Limitations

The assumptions and limitations relative to the assessment of Project effects and the assessment of cumulative effects are:

- There are inherent limitations associated with the use of viewshed modelling, such as the
 overestimation of visible areas. However, the inclusion of vegetation height and
 conservative methods addressed these potential limitations.
- There are no regulations in BC that specifically govern the effects of mine development on visual resources, nor are there any established procedures prescribing how to evaluate the Potential Effects of mine development on visual resources.
- The VLI and RFI data layers are specific to forest harvesting and may not account for all landscape features rated by the public as significant and sensitive in terms of recreation and scenery. However, stakeholder feedback on visual resources was incorporated into the assessment.
- The resolution of the raster data was ±30 m, which is considered optimal for the dimensions of the study areas.



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Table 19.4.3-11: Summary of Significance of Cumulative Effects

					Criteria				Level of		Level of
Evaluation Site	Sensitive Receptor	Context	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood Determination	Confidence for Likelihood	Significance Determination	Confidence for Significance
1. Stellako River	Stellako River Crossing Point	Neutral	Low	Local	Long- term	Intermittent	Yes	High	High	Not Significant (minor)	Moderate
3. Cheslatta Trail	Cheslatta Trail Crossing Point	Neutral	Low	Local	Long- term	Intermittent	Yes	High	High	Not Significant (minor)	Moderate
5. Nechako River Valley	Nechako River Crossing Point	Neutral	Low	Local	Long- term	Intermittent	Yes	High	High	Not Significant (minor)	Moderate
7. Brewster Lake	Brewster Lake Recreation Site	Neutral	Low	Local	Long- term	Intermittent	Yes	Moderate	Moderate	Not Significant (minor)	Low
9. Tatelkuz Lake	Tatelkuz Lake Southeast Recreation Reserve	Neutral	Medium	Local	Chronic (permanent)	Continuous	No	High	High	Not Significant (moderate)	High
	Dykam Ranch	Neutral	Medium	Local	Chronic (permanent)	Frequent	No	High	High	Not Significant (moderate)	High
	Tatelkuz Lake IR 28	Neutral	Medium	Local	Chronic (permanent)	Frequent	No	High	High	Not Significant (moderate)	High



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19.4.3.3.5 Conclusion

This subsection provides a conclusion regarding the significance of residual effects and cumulative effects.

Potential effects of the Project were assessed within the context of the regional topography, existing land use plans, available recreation and scenic inventories, and current land uses and their resultant impacts on scenic quality. The VFD is strongly influenced by silviculture practices with forest cut blocks altering the natural setting in most viewscapes within the Visual Resources study areas. Scenic areas, as identified by the VLI, are less affected and represent remaining high value visual resources. Recreation sites are consistently located within these scenic areas where scenic quality is maintained through integrated resource management and planning.

The assessment focused on thirteen evaluation sites where the Project may interact with visual resources. Within these sites, high recreational significance and moderate to very high visual sensitivity overlapped with locations where users and residents were expected to congregate. Effects were considered to occur when Project components are within line of sight of these sensitive receptors. After consideration of mitigation measures embedded in the project design, clear and efficient measures were proposed to mitigate significant adverse effects of the project.

The Effects Assessment took into account the magnitude, geographic extent, duration, frequency, and reversibility of effects to determine the significance of Residual Effects attributable to each site. Effects were considered Not Significant (negligible) at the Endako and Francois Lake road crossing points and at Tahultzu Lake, Chief Grey Lake, Hobson Lake, Chedakuz Lake, Top Lake, Snake Lake, and Kuyakuz Lake.

Effects were considered Not Significant (minor) at the Cheslatta Trail crossing point and Brewster Lake, and Not Significant (moderate) at the Stellako and Nechako River crossing points and Tatelkuz Lake east bank locations. The Stellako River crossing point is considered to be Not Significant (negligible) if the reroute along the existing transmission lines is selected.

Cumulative Effects were assessed for evaluation sites rating higher than Not Significant (negligible).Brewster Lake and the Stellako River, Nechako River and Cheslatta Trail crossing points, received a cumulative effects rating of Not Significant (minor). Cumulative effects at the Tatelkuz Lake east bank locations are considered to be Not Significant (moderate).



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ANNEX A Project Inclusion List for Cumulative Effects Assessment



Appendix 19A Project Inclusion List

NLTU LS		udy Area (based NTLU RSA)	Land Use Type	Project	Location	Status	Distance/ (km) and direction from Project	Developer / Company	Cost (millions)	Start	Finish	Description	Spatial overlap with Project	Temporal overlap with Project	Include in Cumulaltive Effects Assessment
		GENERAL	LAND USES DES	SCRIBED IN NON-TI	RADITIONAL LAND USE SECTION (APPENDIX XX)							RATIONALE FOR INCLUSION			
No	Yes		Community	District of Vanderhoof	Located at the geographic centre of BC, 100 km west of Prince George along Hwy 16.	On-going	~ 100 km north of the Project mine site	n/a	n/a	Ongoing	Indefinite	Vanderhoof is a community of 4,480 residents and is a service centre to the surrounding rural population. The community reported a positive rate of growth from 2006 to 2011 by 10.2%. Today, important industries still include agriculture and logging as well as tourism. The community is accessible by Hwy 16 and commercial transportation in and out of Vanderhoof includes bus service as well as train. Vanderhoof is the closest urban centre to the proposed mine site.	Yes	Yes	Yes Inclusion to be evaluated specifically for each VC
No	Yes		Community	Village of Fraser Lake	Located south of Fraser Lake along Hwy 16 between the proposed northern terminus of the transmission line and access route on Hwy 16.	On-going	~ 90 km north of the Project mine site	n/a	n/a	Ongoing	Indefinite	The community reported a population of 1,167 in 2011, which was a 4.9% increase from 2006. Endako Mine and Fraser Lake Sawmill employs the majority of Fraser Lake residents.	Yes	Yes	Yes Inclusion to be evaluated specifically for each VC
Yes	Yes		Parks and Protected Areas	Various	Various - refer to NTLU Baseline Report appended to this application Figure 1 and 2 in Appendix 4E-1	On-going	Various	n/a	n/a	Ongoing	Indefinite	The Stellako River Wildlife Management Area, located between Fraser and Francois Lakes, is intersected by the transmission line (main) study area. No other parks or protected areas are intersected by the Project LSA; although several areas are located 3 to 5 km from the FSR or transmission study area.	Yes	Yes	Yes Inclusion to be evaluated specifically for each VC
Yes	Yes		Mining	Exploration / developed prospects, prospects and showings	Various - refer to NTLU Baseline Report appended to this application Figure 1 and 2 in Appendix 4E-1	Historical / active and pending	Various	Various	n/a	Ongoing	Indefinite	Two developed prospects: - Vanderhoof Limestone (MINFILE No. 093G 008) is located 19 km southeast of Vanderhoof and was last sampled in 1988. - Capoose property (MINFILE No. 093F 040) owned by the Proponent. One prospect: one prospect, Blackwater-Davidson (MINFILE No. 093F 037) represents proposed Project. Three showings: two along transmission line and one along FSR access route Numerous registered mineral claims and tenures overlap the LSA and fall within the RSA.	Yes	Yes	Yes Inclusion to be evaluated specifically for each VC
Yes	Yes		Mining	Mineral Claims and Tenures	Various - refer to NTLU Baseline Report appended to this application Figure 1 and 2 in Appendix 4E-1	Active	Various	Various	n/a	Ongoing	Indefinite	Numerous registered mineral claims and tenures overlap the LSA and fall within the RSA.	Yes	Yes	Yes Inclusion to be evaluated specifically for each VC
Yes	Yes		Mining	Endako Molybdenum Mine	Near Fraser Lake approximately 65 km west of Vanderhoot	. Operating		Thompson Creek Metals Company Inc.	n/a	1965. Upgraded in 2012	March 2012	Operated as a joint venture with Thompson Creek holding a 75% interest and Sojitz Corporation, a Japanese company, holding a 25% interest. The Endako Mine, surface molybdenum mine which began operations in 1965, was upgrated in 2012. The Endako Mine consists of three pits. The Endako Pit, the largest, was the focus of mining activity for many years. In January 2008, mining activity shifted entirely to the Denak West Pit and during 2008 the in-pit crusher was moved from the Endako Pit to an area between the Denak West and Denak East pits and an overland conveyor was installed from that location to the mill. The conveyor commenced transporting ore to the mill in March 2009. Plans call for the creation of a single pit by mining the walls between the three existing pits. (Thomson Creek 2013 - http://www.thompsoncreekmetals.com/s/Endako_Mine.asp)		Operations - Yes	Yes Inclusion to be evaluated specifically for each VC
Yes	Yes		Forestry	Logging activities	Various - refer to NTLU Baseline Report appended to this application Figure 1 and 2 in Appendix 4E-1	Historical	Various	Various	n/a	n/a	pre 2012	Timber harvesting in the area began in the late 1980s. The historical / retired data represents areas already logged. 1,973 forestry tenures (representing 61% of the NTLU RSA) were retired between 2005 and 2011 in the NTLU RSA. Historical cutblocks are located throughout the Project LSA.	a Yes	Yes	Yes Inclusion to be evaluated specifically for each VC
Yes	Yes		Forestry		Various - refer to NTLU Baseline Report appended to this application Figure 1 and 2 in Appendix 4E-1	Active and pending	Various	Various	n/a	Ongoing	Indefinite	Represents areas to be logged as part of the Mountain Pine Beetle Action Plan . 1,267 forest tenures fall within the NTLU RSA which are divided between 1% pending (44 tenures) and 38% active (1,223 tenures). A varety of active and pending forest tenures owned by logging companies and First Nations are intersected by the Project LSA. Numerous tenure areas identified as Future Harvesting Inventory are intersected by the Project LSA. Several areas designated as having silviculture obligations also fall within the Project LSA.	Yes	Yes	Yes Inclusion to be evaluated specifically for each VC
Yes	Yes		Forestry	Woodlot Licences	Various - refer to NTLU Baseline Report appended to this application Figure 1 and 2 in Appendix 4E-1	Active and pending	Vatious	Various	n/a	Ongoing	Indefinite	A Woodlot Licence is a legal agreement between the Forest Service and the licence holder that grants exclusive rights to manage and harvest Crown timber within the woodlot licence area. Two woodlot licences are intersected by the mair transmission line study area; one of these woodlots is also intersected by the Mills Ranch re-route; and the other one is also intersected by the Stellako re-route. Eight registered woodlot licence holders with a total of 13 tenures are intersected by the FSR study area.	S	Unknown	Yes Inclusion to be evaluated specifically for each VC
Yes	Yes		Forestry	Private Forest Lands	Various - refer to NTLU Baseline Report appended to this application Figure 1 and 2 in Appendix 4E-1	Active and pending	Vatious	Various	n/a	Ongoing	Indefinite	The Private Managed Forest Land Program encourages private landowners to manage their lands for long-term forest production. Active forest tenures owned by private individuals are intersected by the Project LSA.	Yes	Unknown	Yes Inclusion to be evaluated specifically for each VC
Yes	Yes		Hunting	Resident, Trapping and Guide Outfitting	Various - refer to NTLU Baseline Report appended to this	On-going	Vatious	Various	n/a	Ongoing	Indefinite	Residents in the area most commonly hunt moose, deer, wolf, and black bear, but also cougar, coyote, wolverine, lynx, and snowshoe hare. A total of 14 guide outfitter areas overlap the NTLU RSA with nine guide outfitters overlapping the Project LSA. A total of 78 registered traplines overlap the NTLU RSA with 22 traplines overlapping the Project LSA.	Yes	Yes	Yes Inclusion to be evaluated specifically for each VC

Appendix 19A Project Inclusion List

NLTU LS	CEA Study Area (based on NTLU RSA)	Land Use Type	e Project	Location	Status	Distance/ (km) and direction from Project	Developer / Company	Cost (millions)	Start	Finish	Description	Spatial overlap with Project	Temporal overlap with Project	Include in Cumulaltive Effects Assessment
Yes	Yes	Fishing	n/a	Various - refer to NTLU Baseline Report appended to this application Figure 1 and 2 in Appendix 4E-1	On-going	Vatious	Various	n/a	Ongoing	Indefinite	The Vanderhoof area is a popular fishing destination due to the area's vast network of streams, rivers, and lakes. A number of streams, rivers, and lakes are a short distance away from Vanderhoof and are accessed by paved or FSRs, while other more distant and less-accessible water bodies are accessed by kayak, canoe, boat, or float plane	Yes	Yes	Yes Inclusion to be evaluated specifically for each VC
Yes	Yes	Agriculture	Individual propertie	es Various - refer to NTLU Baseline Report appended to this application Figure 1 and 2 in Appendix 4E-1	n-going	Vatious	Various	n/a	Ongoing	Indefinite	Four ALR properties are overlapped 86% by the main transmission line study area. Three ALR properties are intersected by the Stellako re-route (which accounts for 10% of the total Stellako re-route) and three ALR properties are overlapped by the existing portion of the FSR study area. There are a total of 69 active range tenures and three pending range tenures overlapping the NTLU RSA with 9 range tenure areas from eigth tenure holders overlapping the LSA.	Yes	Yes	Yes Inclusion to be evaluated specifically for each VC
Yes	Yes	Recreation	Back country hikin camping,ATVing, etc along trails and recreation sites		On-going	Vatious	Various	n/a	Ongoing	Indefinite	The area overlapping the NTLU RSA is used year-round for a variety of recreational uses including all-terrain vehicle use (ATVing), snowmobiling, hiking, camping, cross-country skiing, horseback riding, fishing, hunting, interpretive cultural heritage experiences, and eco-tourism. There are several historically and culturally significant trails located within 20 km of the Project including the Alexander Mackenzie Heritage Trail, Messue Wagon Road, and Messue Horse Trail/Kluskus Bypass. The Alexander MacKenzie Heritage Trail passes 15 km south of the proposed mine site in an east-west direction. There is a non motorized recreational trail, the Messue Wagon Road, 13 km directly east of the mine site, running in a north-south direction, which will be crossed by the proposed fresh water pipeline from Tatelkuz Lake to the mine site. The Carrier Indian Trail route from the southeast, through the Chedakuz Valley to Cheslatta and north (used prior to the Nechako Reservoir development in the 1950s) is a continuation of the Messue Trail from the Messue Indian Reserve on the northwest end of Tatelkuz Lake. In total 14 forest recreation sites / trails are overlapped by the Project LSA.	Yes	Yes	Yes Inclusion to be evaluated specifically for each VC
No	Yes	Recreation	Accomadation at lodges	Various - refer to NTLU Baseline Report appended to this application Figure 1 and 2 in Appendix 4E-1	On-going	Vatious	Various	n/a	Ongoing	Indefinite	Twenty-three commercial lodges fall within the NTLU RSA: - Crystal Lake Cabins (part of Crystal Lake Resort) are located aproximately 3 km east of proposed transmission line and 60 km northeast from mine site. - Finger Creek Ranch is located <1 km from the FSR study area and 48 km from the mine site. - Finger Lake Resort is located approximately 2 km south of the FSR study area and approximately 50 km northeast of the mine site. - Tachick Lake Resort is located approximately 2 km east from FSR study area, approximately 88 km northeast of mine site. - Tatelikuz Resort is located on Tatelkuz Lake (where the water pipeline starts) < 2 km south of the FSR study area and approximately 8.5 km from the proposed mine site. The remaining lodges are located at least 5 km from the nearest project facility / component.	Yes	Yes	Yes Inclusion to be evaluated specifically for each VC
Yes	Yes	Transportation	Traffic along Kluskus FSR	Various - refer to NTLU Baseline Report appended to this application	n-going	Vatious	Various	n/a	Ongoing	Indefinite	Miscellaneous traffic associated with recreational land use and other commercial / industrial activities in the area.	Yes	Yes	Yes Inclusion to be evaluated specifically for each VC
No	Yes	Transportation	Airports, airstrips and aerodromes	Figure 1 and 2 in Appendix 4E-1 Various - refer to NTLU Baseline Report appended to this application Figure 1 and 2 in Appendix 4E-1	On-going	Vatious	Various	n/a	Ongoing	Indefinite	Vanderhoof has two airports, including the Vanderhoof District Water Aerodrome (CAN9), located 22 km east at the north end of the existing FSR study area and the Vanderhoof Airport (CAU4), located approximately 4 km further east. Fraser Lake may be accessed by planes landing at the Fraser Lake Airport (CBJB), located approximately 29 km west of the north end of the FSR study area, or at the Fraser Lake Aerodrome (CBZ9), located approximately 10 km north of CBZ9 Approximately 17 km (in a straight-line distance) to the south of the proposed mine site is the turf/gravel Tsacha Lake Airport (CAE4); 26 km southwest of the mine site is the Tsetzi Lake (Pan Phillips) Airport (CBT3), and 28 km west of that are the Moose Lake (Lodge) Airport (CAS2) and Moose Lake (Lodge) Seaplane Base (CBE8).	Yes	Yes	Yes Inclusion to be evaluated specifically for each VC
Yes	Yes	Crown Land Tenures	Various	Various - refer to NTLU Baseline Report appended to this application Figure 1 and 2 in Appendix 4E-1	ctive and ending						No registered Crown tenures overlap the mine site, mine site access road, airstrip or water supply study areas. Seven provincial Crown tenures licensed for agriculture, environment, institutional, quarrying and residential overlap the transmission line study area. Eight provincial Crown tenures licensed for environment/conservation/recreation, quarrying and residential overlap the Stellako re-route study area. No registered Crown land tenures overlap with the Mills Ranch re-route study area. Fourteen provincial Crown tenures licensed for agriculture, environment, industrial, quarrying, and residential overlap the FSR study area. The main transmission line study area and Stellako re-route both overlap 12 utility tenures. Three utility tenures are intersected by the FSR study area.		Yes	Yes Inclusion to be evaluated specifically for each VC
Yes	Yes	Water Licences	Various	Various - refer to NTLU Baseline Report appended to this application Figure 1 and 2 in Appendix 4E-1	ctive and ending						Two groundwater wells, both owned by the proponent, are registered within the mine site study area. Two groundwater wells are registered within the mine site study area. Two groundwater wells are registered within the main transmission line study area. Two different groundwater wells are intersected by the study area for the Stellako re-route. Well ID 96878 (which is overlapped by the main transmission line study area is also overlapped by the FSR study area. Nine groundwater wells are registered within the FSR study area; five of which appear to be for private domestic use. Four current points of diversion (POD) are overlapped by the FSR study area. These PODs are all located near the northern end of the FSR study area (i.e. near Highway 16).		Yes	Yes Inclusion to be evaluated specifically for each VC

Appendix 19A Project Inclusion List

NLTU LS/	CEA Study Area (based on NTLU RSA)	Land Use Type	Project	Location	Status	Distance/ (km) and direction from Project	Developer / Company	Cost (millions)	Start	Finish	Description	Spatial overlap with Project	Temporal overlap with Project	Include in Cumulaltive Effects Assessment
		PR	OPOSED PROJEC	TS (as of November 2013)										
No	Yes	Utilities	Nulki Hills Wind Project	Nechaco Development Region: - 30 km south of Vanderhoof.	Pre-application stage in BCEAO process (commenced November 26, 2012). No info provided on Company website.	- 60 km north / northeast of Project mine site 5 km east of the Kluskus FSR (at its closest point)		\$45	Unknown. Preliminary Project Description filed with BCEAO indicates the following: Construction - summer 2015 to early 2017. Project Commissioning - summer 2017	Indefinite	Innergex Wind Energy Inc. (Proponent) proposes to develop and operate a wind power project with a nameplate capacity ranging from 105 to 210 megawatts. The proposed Project would be located in the Nulki Hills, 30 km south of Vanderhoof, British Columbia and includes up to 70 wind turbines. (BCEAO website - http://a100.gov.bc.ca/appsdata/epic/html/deploy/epic_document_391_35124.html/Pers. Comm (July 22, 2013) Mr. Nuno Louzeiro, Environmental Engineer Innergew Wind Energy Inc. Mr. Louzeiro indicated that although the Nulki Hills Wind Project was waiting for an Electricity Purchase Agreement to be set up the project was proceeding through the BCEAO process.	transportation, social and economics perspective	Unknown Presumed that construction and / or operations will overlap with Blackwater Project	Yes Inclusion to be evaluated specifically for each VC
No	Yes	Utility	Fraser Lake Sawmill Biomass Project	Nechako Development Region: Fraser Lake	Permitting in process.	~ 80 km north of the Project mine site.	West Fraser Mills Ltd	\$20	Preliminary site preparation underway	commence 2nd or 3rd quarter of 2014.	Proposed 12 MW (88 GWH/year electricity) plant will use sawmill waste to produce energy. Project selected to proceed in the Phase 2 Bioenergy Call for Power and has been awarded a BC Hydro Electricity Purchase Agreement. Proposed (April 4, 2011 - http://www.westfraser.com/investors/news/news-releases/west-fraser-announced-preferred-proponent-two-phase-ii-bioenergy-projects) Pers. Comm. (July 22, 2013) Mr. Larry Hughes, VP, CFO, Secretary West Fraser Mills Ltd. Mr. Hughes indicated that the project was moving forward and that investors were being advised that project start-up was scheduled for Q2 - Q3 of 2014.			Yes Inclusion to be evaluated specifically for each VC
No	Yes	Utlity	Coastal GasLink Pipeline Project	Northwast Development Region: Dawson Creek	Pre-application stage in BCEAO process (commenced December 11, 2012).	North of the Project minesite.	Coastal Gaslink Pipeline Ltd.	\$4,000	2015 acording to the June 2013	2019	The proposed Project involves the construction and operation of an approximately	transportation, social and	Yes Construction - potentially, depends on schedule	Yes Inclusion to be evaluated specifically for each VC
No	Yes	Utlity	Pacific Gas Loopin Project	Natural gas transmission pipeline between Summit Lake,		minesite.	Pacific Northern Gas Ltd.	-	-	-	The proposed Project involves the construction of approximately 525 kms of new 24-inch pipe, operating in parallel with the existing pipeline.	transportation, social and		Yes Inclusion to be evaluated specifically for each VC

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ANNEX B Spatial Boundaries for Projects and Activities Included in the Cumulative Effects Assessment



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SPATIAL BOUNDARIES FOR PROJECT AND ACTIVITIES INCLUDED IN THE CUMULATIVE EFFECTS ASSESSMENT

1.0 INTRODUCTION

The Project Inclusion List (PIL) presented in **Appendix 4A** lists all relevant and substantial projects and activities in the Non-Traditional Land Use Regional Study Area (NTLU RSA) of the Project. Spatial boundaries for these projects and activities have been identified for the following land use types as listed in the PIL:

- Community;
- Mining;
- Forestry;
- Infrastructure (transportation, utilities);
- Agriculture;
- Crown land tenures:
- Hunting;
- Fishing;
- Recreation; and water licenses.

Where possible, the spatial footprint of a project was captured to enable area calculations. Projects and human activities where area calculations could be generated are presented in **Figure 1**. Activities taking place in a variable manner within a larger area are presented in **Figure 2**. Information presented in these maps will be used for the Cumulative Effects Assessment (CEA) for each of the Valued Components (VC).

The following section describes the methodology used to determine spatial boundaries for the Project and activities.

2.0 METHODS

Figures and area calculations were generated for the CEA, by investigating and rationalizing items on the PIL, to represent past, present, and future activities within the Local Study Area (LSA) and Regional Study Area (RSA) of the various disciplines. Layers were mapped for the extent of the NTLU RSA and focused for RSAs and LSAs of each discipline.

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Research and mapping methodologies and Record of Contacts (ROCs) are summarized below:

Community: Municipal and town boundaries were incorporated from the regional district electoral area spatial layer. This included the main areas and outlier communities of the Municipality of Vanderhoof and the Village of Fraser Lake.

Mining: Research into prospecting activities and active mining projects was accomplished by investigating the mineral deposits and mineral tenures spatial layers from the BC Ministry of Energy and Mines (BC MEM).

Mrs. Bambi Spyker, Operations Coordinator at BC MEM was contacted by phone and e-mail to obtain data on Notices of Work (NOWs) for exploration programs conducted nearby the Project.

Information was gathered from the websites of exploration companies on NOWs while publically available documents were sourced to obtain maximum footprints of current and proposed mining projects. The BC Major Projects Inventory (June 2013) from the BC Ministry of Jobs, Tourism and Skills Training (BC MJTST) was examined to identify the status of proposed mining projects.

Where detailed information was readily available, drilling holes (30-m diameter) and prospecting tracks (10 m total width) were buffered to represent the footprint of current activities. Where prospecting activities could be confirmed, but not pinpointed to a specific footprint, the full extent of the mineral tenure was mapped and labelled to enable a description by discipline leads for their various cumulative effects sections. Quarries from the crown tenure purpose spatial layer was incorporated to include areas where sand and gravel are sourced and rock-crushing activities are taking place. Proposed mining projects that have been withdrawn or put on hold were not included.

The following data hosts were contacted to verify scientific judgments and hypothesis:

- Prince George Operations Coordinator, BC MEM; and
- Sue Bergin, MFLNRO Information Management Branch, Sue.Bergin@gov.bc.ca, (250) 387-9168.

Forestry: The BC Ministry of Forests, Lands and Natural. Resource Operations (BC MFLNRO) uses three different spatial data layers to manage silviculture operations in the Vanderhoof Forest District. The *silviculture obligations spatial layer* captures areas with intended forest management activities on crown land. The *operational activities spatial layer* reflects operational activities for cut blocks contained within harvesting authorities. Active cutblocks from these two layers were combined to represent the spatial footprint of present silviculture operations. Retired cutblocks were selected to represent past effects. The harvesting inventory spatial layer analyzes all vegetation types in terms of age, species, volume, height, and growth for potential harvesting. These areas represent likely future activities for the purposes of the CEA.

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Private license holders were included by incorporating the woodlot license spatial layer. Active licenses were classified as present effects with pending licenses representing future effects. A woodlot license is a legal agreement that grants the license holder exclusive rights to manage and harvest Crown timber within a parcel of land. To follow a conservative approach, it was assumed that the entire parcel would be harvested. Active woodlot licenses were classified as present effects with pending licenses classified as future effects.

Planned activities by private companies were included by obtaining pending applications for expansions from CANFOR not yet processed by BC MFLNRO. These areas were critical as they fall within the ungulate winter range along the west-facing slopes of Mount Davidson. Forestry Service Roads (FSRs) and associated logging roads were buffered, using the Digital Road Atlas spatial layer, to represent the width of the right of way (ROW):

Main FSRs (Kluskus, Kluskus-Ootsa, Kluskus-Blue)	. 40 m total width
Other FSRs (Messue, Malaput, Natalkuz etc.)	. 30 m total width
Logging roads	. 15 m total width

The following data hosts were contacted to verify scientific judgments and hypothesis:

- Jayne Wynrib, BC MFLNRO GeoBC, Jayne.Wynrib@gov.bc.ca, (250) 952-4776; and
- Ian Niblett, Vanderhoof Forest District, (250) 567-6474.

Infrastructure (transportation, utilities): The BC Major Projects Inventory (June 2013) from the BC MJTST was examined to identify the status of infrastructure projects over \$15 million. Energy production, transportation and utility ROWs as well as verified biomass and wind energy projects, were included from the crown tenure purpose spatial layer. Airports, airstrips, and waterdromes were added as point locations.

Agriculture: Range tenures were included as mapped for the NTLU RSA with emphases placed on those overlapping the various LSAs. Active range tenures were classified as present effects with pending tenures classified as future effects. The Nechako Agricultural Land Reserve, incorporating various extensive, intensive, and grazing crown tenures, was also included.

Crown Land Tenures: Crown land tenures referred to various land use types and available information was presented under mining, agriculture, and infrastructure.

Hunting: Wildlife management areas, guide outfitters, and traplines were incorporated on the activity figure with emphases placed on those overlapping with the various LSAs.

Harvesting statistics for the wildlife management units 5 to 12, 5 to 13, 7 to 11, and 7 to 12 were obtained by contacting Doug Heard (BC MFLNRO, Prince George, via e-mail).

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Fishing: Waterbodies known for recreational fishing activities as presented in the Non-Traditional Land Use Baseline Report (AMEC, 2013) have been labelled in the figures.

Recreation: Recreation sites and trails, and lodges were incorporated on the activity figure with emphases placed on those overlapping or near the various LSAs (AMEC, 2013).

Water Licenses: Due to the high number of groundwater wells, drinking water sources and water wells, only those falling within the largest LSA were incorporated on the activity figure (Noise, 5 km buffer). Locations falling within the Aquatic RSA were highlighted as the most critical.

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REFERENCES

AMEC Environmental & Infrastructure (AMEC) (2013). Proposed Blackwater Gold Project, Non-Traditional land Use Baseline, prepared for New Gold Inc., July 2013.

