Coffee Gold Mine

YESAB Project Proposal

Appendix 16-B Wildlife and Wildlife Habitat Valued Component Assessment Report

VOLUME III

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ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
ARD/ML	Acid Rock Drainage and Metal Leaching
BMPs	Best Management Practices
CEA	Cumulative Effects Assessment
ICMC	International Cyanide Management Code
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
EC	Environment Canada
EDI	Environmental Dynamics Inc.
FNNND	First Nation of Na-cho Nyäk Dun
GIS	Geographic Information System
HLF	Heap Leach Facility
Kaminak	Kaminak Gold Corporation
LAA	Local Assessment Area
LSA	Local Study Area
NAR	Northern Access Route
Project	Coffee Gold Mine Project
RAA	Regional Assessment Area
SARA	*Species at Risk Act*
SFN	Selkirk First Nation
TH	Tr’ondëk Hwëch’in
TK	Traditional Knowledge
TWG	Technical Working Group
VC	Valued Component
WPP	Wildlife Protection Plan
WRFN	White River First Nation
WRSF	Waste Rock Storage Facilities
YCDC	Yukon Conservation Data Center
YESAA	*Yukon Environmental and Socio-economic Assessment Act*
YESAB	Yukon Environmental and Socio-economic Assessment Board
YG	Yukon Government
YT	Yukon Territory
ZOI	Zone of Influence

UNITS AND MEASURES

Abbreviation	Measurement
%	Percent
g	Gram
ha	Hectare
hr	Hour
km	Kilometre
km^2	Square Kilometre
m	Metre
m^2	Square Metre
m^3	Cubic Metre
mg	Milligram
Mt	Million Tonnes
t	Tonne
tpd	Tonnes per day
µm	Micrometre
V	Volt
W	Watt

1.0 INTRODUCTION

This report provides an assessment of the potential effects and cumulative effects of the proposed Coffee Gold Mine (Project, described in detail in **Volume 1, Section 2.0 Project Description**) on the Valued Component (VC) Wildlife and Wildlife Habitat. Subcomponents and indicators are used to focus the assessment on information known to be important to First Nations, government, and other technical reviewers. The report identifies and characterizes potential interactions between the Project and Wildlife, and describes the mitigation measures and protection plans that Kaminak Gold Corporation (the Proponent) will implement to eliminate, reduce, or otherwise control adverse Project-related effects on Wildlife and Wildlife Habitat.

This report is structured so that reviewers can find the information required to review the assessment of the Project's potential effects on Wildlife. The Introduction section provides the rationale for the selection of Wildlife and Wildlife Habitat as a VC, explains the selection of Wildlife subcomponents, and describes the scope of the assessment. The indicators used to assess the potential Project-related effects on Wildlife are provided and the temporal, spatial, and technical assessment boundaries are identified.

The Assessment Methods section describes the quantitative and qualitative approaches used in assessing potential Project-related effects and cumulative effects on Wildlife and Wildlife Habitat. The methods focus on using the best available information, analysis and environmental assessment best practice for identifying potential effects on Wildlife and Wildlife Habitat. While general methods of the overall assessment are described in **Volume 1, Section 5.0 Assessment Methodology**, the methods described in this section are specific to Wildlife.

The Existing Conditions section describes Wildlife baseline conditions that are relevant to potential Project interactions. It includes a summary discussion of the regulatory context in which the Proponent assessed effects and proposed management and mitigation measures to reduce effects on Wildlife. It includes a section discussing how traditional knowledge (TK) was incorporated in the assessment methods, where scientific and other studies were used, and how the information from baseline studies conducted for Project was used. The section concludes with a summary of the existing Wildlife and Wildlife Habitat conditions to place the following effects assessment in the context of local conditions.

The Assessment of Project-Related Effects section provides the technical details that describe the potential effects of the Coffee Project on Wildlife. The section identifies the potential Project interactions with Wildlife and Wildlife Habitat, identifies mitigation measures that are implemented at the Project design level, and outlines other wildlife-specific measures that can be used by the Proponent in the design and management of the Project to reduce or eliminate potential effects. The section describes the Proponent's commitments related to the elimination or reduction of adverse effects on Wildlife and Wildlife Habitat. Potential residual effects (i.e., adverse effects remaining following the application of mitigation measures) are identified and a determination of the significance of those effects is presented. The technical details of the effects on Wildlife subcomponents are provided in subsections.

The Assessment of Cumulative Effects section provides a broader overview of the potential combined effects of past, present, and reasonably foreseeable future projects and activities on Wildlife and Wildlife Habitat. The section characterizes the combined residual Project-related effects (i.e., those effects that cannot be completely avoided) with the residual effects of other project and activities that have occurred, are currently occurring, or are likely to occur to wildlife. A list of those projects and disturbances considered in the cumulative effects assessment are identified in this section. Where necessary, and if separate from Project-related effects, mitigation measures to address potential cumulative effects are described.

The Assessment of Accidents and Malfunctions section describes worst-case scenarios of Project facility failure and unexpected mitigation action failure. The Proponent is including an assessment of accidents and malfunctions to address concerns identified during the scoping and engagement period. This section provides a mostly qualitative characterization of the potential worst-case scenario effects on Wildlife and Wildlife Habitat.

The Summary of Effects Assessment on Wildlife and Wildlife Habitat section provides an overview of the technical assessments described in the Project-related Effects, Cumulative Effects, and Accidents and Malfunctions assessment sections.

The Effects Monitoring and Adaptive Management section describes the actions that the Proponent will implement during the Project's Construction, Operation, Reclamation and Closure, and Post-closure phases. The section describes the approach that the Proponent will take to verify effects assessment findings and the effectiveness of mitigation measures, and to actively respond to and manage unexpected effects as the Project proceeds. It identifies how mitigation measures may be modified in the event of unexpected Project-related or cumulative effects and provides for continued collaboration with First Nations and regulators during Project monitoring and effects management decision-making. It demonstrates the Proponent's commitment to regular monitoring and re-assessment, and its willingness to implement changes necessary to effectively mitigate Project-related or cumulative effects on Wildlife.

1.1 Issues Scoping

For the purposes of this effects assessment, Wildlife includes all wild animals except for birds. The Birds and Bird Habitat VC Assessment Report is presented in **Appendix 17-B**. The scope of this assessment is based on various guidelines provided by the Yukon Environmental and Socioeconomic Assessment Board (YESAB) and by input from regulators, First Nations, and stakeholders. Through engineering and baseline studies conducted during the Project's Feasibility Study (July 2014 to December 2015), the Project team reviewed a mine plan and detailed technical information related to physical and biophysical values in the vicinity of the Project, including the Mine Site and Northern Access Route (NAR). Available information regarding other existing and proposed quartz mining projects in the Yukon and other parts of northern Canada, including environmental assessments, were reviewed. Issues and concerns were also identified through consultation and engagement activities with communities, stakeholders and affected First Nations. All of this information supported scoping the effects assessment, including the identification of candidate VCs, and in many cases, subcomponents (i.e., components of a broadly defined VC that help to frame the VC assessment).

The scope of assessing Wildlife considered the Project's potential direct and indirect effects, residual effects and cumulative effects associated with Construction, Operation, Reclamation and Closure, and Post-closure phases. The initial step in the effects assessment process was the completion of the Wildlife Baseline Report (**Appendix 16-A**). The baseline report characterizes the existing wildlife conditions upon which the Project may have an effect.

Issues scoping for Wildlife required knowledge of the Project design and wildlife species likely to occur in the region, including those considered to be at-risk or of conservation concern, as well as an understanding of species' sensitivities and their appropriateness as representative species (i.e., VC subcomponents). Wildlife-related information of relevance to the assessment was identified through discussions with Environment Canada (EC) and Yukon Government (YG) biologists, and review of various published and unpublished sources, including YG Moose (*Alces alces*), Thinhorn Sheep (*Ovis dallii*), and Caribou survey and collar data, and fur and big game harvest data, data from other projects undertaken in the region (e.g., Casino Mining Corporation 2013), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) species online search tool, and available TK and scientific literature.

The Proponent has undertaken an engagement and consultation process, as defined under Section 50(3) of the *Yukon Environmental and Socio-economic Assessment Act* (YESAA), to support the scoping of issues for the Project (Refer to **Volume I, Section 3.0 Consultation**). The Proponent continues to consult and engage with affected First Nations and communities, government agencies, and interested persons and/or other stakeholders who may be interested in the Project and its related activities. This consultation and engagement process included meetings with First Nations and government departments (e.g., YG and EC), community meetings, one-on-one and small group meetings, and ongoing communications such as print communication, newsletter, and website updates, including specific presentations and discussions regarding birds and exploration of Wildlife and Wildlife Habitat as a candidate VC. The consultation and engagement process also included the establishment of the Tr'ondëk Hwëch'in (TH) Technical Working Group (TWG) which was formed during the Project scoping stage to provide the Proponent with ongoing advice and detailed information to better inform their environmental baseline and effects assessment programs for the Project. Meetings with the TH TWG included discussions of Project baseline studies for wildlife, the inclusions of specific species/species groups as candidate subcomponents for the Wildlife and Wildlife Habitats VC, and concerns around potential Project-related effects to wildlife (TH TWG, Pers.

Comm., 2016). Comments received through the consultation and engagement process from the TH TWG, YG, EC, and Project stakeholders were generally supportive of the identification of Wildlife and Wildlife Habitat as a VC for the Project.

Throughout the consultation and engagement process, potential effects on Wildlife and Wildlife Habitat were raised as a key concern by the TH TWG, Environment Yukon, Environment Canada, First Nations, Project stakeholders, and members of the public. While the general consensus at community meetings and in other Project consultations was that the potential Project-related effects to wildlife are mitigatable, numerous concerns were raised. One of the most commonly raised concerns about wildlife was around potential effects to the Fortymile Caribou herd (*Rangifer tarandus grantii*), identified as a particular concern due to the recent population recovery and re-establishment of previously abandoned winter range in the north and central Yukon. Another common concern was the possibility that the NAR could contribute to increased harvest in the central Yukon region, particularly for Moose. Each of these concerns were raised by both TH and non-TH citizens residing in Dawson, as well as by government regulators. Other issues and concerns raised in relation to potential effects of the Project on Wildlife (e.g., Ayoub, Pers. Comm. 2016; Becker, Pers. Comm. 2016; Interview 14, Pers. Comm. 2016; Interview 15, Pers. Comm. 2016; Meister, Pers. Comm., 2016; TH TWG, Pers. Comm. 2016; Suitor 2016; among others) include:

- Habitat loss resulting from land and vegetation clearing
- Displacement and functional habitat loss along the NAR and at the Mine Site, particularly during key periods/seasons (e.g., post-rut)
- Effects to wildlife during sensitive times (e.g., post-rut, migration)
- Effects to habitat features (e.g., wildlife trees, mineral licks, dens)
- Increased stress levels for Caribou repeatedly exposed to disturbance, potentially resulting in reduced pregnancy and/or lower natal mass
- Disturbance to Sheep in the area, particularly from flights
- Lower survival rates of Caribou, Moose and Sheep, due to increased predation, especially from potential increased mobility of wolves along the NAR
- Increased wildlife mortality resulting from vehicle collisions
- In the future when harvest commences on Fortymile Caribou, higher rates of Caribou harvest due to increased access for hunters
- Higher rates of Moose harvest due to improved access for hunters
- Increased harvest around barge areas
- Ensuring TH hunter access to traditional hunting areas.

1.2 WILDLIFE AND WILDLIFE HABITAT AS A VALUED COMPONENT

As a part of Project scoping, the specific objectives, as identified in YESAB's Proponents Guide to Information Requirements for Executive Committee Project Proposal Submissions (2005), were reviewed. The YESAB guidelines recommend that Wildlife be considered as a candidate VC since "*Wildlife are valued as important ecological components, for aesthetic and cultural reasons, and as a food source, among other reasons…Sensitive species and/or habitats especially should be given consideration as VCs*" (YESAB 2005). The guidelines further recommend that the identification of interactions between the Project and identified VCs include, among others, consideration of:

- Loss of rare, endangered, or valued components
- Reduction in species diversity
- Loss of critical or productive habitats
- Interference with movement patterns.

Throughout the consultation and engagement process, comments received from the TH TWG, Environment Yukon, Environment Canada and Project stakeholders were generally supportive of the identification of Wildlife and Wildlife Habitats as a VC for the Project (see **Section 1.1**). Review of available TK also highlighted the importance of wildlife as an integral part of the natural environment, for example:

> "… *the value of the Coffee Creek region transcends these particular sites and encompasses all of the plants, water, land and wildlife that inhabit or travel through the area. One animal, plant, or heritage site cannot be valued over another, nor can they be viewed in isolation. The Coffee Creek region must be seen as an interconnected whole*..." (Tr'ondëk Hwëch'in 2012a).

> "*We value our natural environment with healthy fish and wildlife populations, clean water, clean air and the natural state of the land.*" (Na-Cho Nyak Dun 2008).

TK also identified the importance of various wildlife species harvested as a food source or for their furs, including Caribou, Moose, Sheep, Bear, Wolf (*Canis lupus*), Wolverine (*Gulo gulo*), Canada lynx (*Lynx canadensis*), Fox, Porcupine (*Erethizon dorsatum*), Marten (*Martes americana*), Mink (*Neovison vison*), Ermine (*Mustela ermine*), Beaver (*Castor canadensis*), Muskrat (*Ondatra zibethicus*), River Otter (*Lontra canadensis*), Snowshoe Hare (*Lepus americanus*), and gopher/ground squirrel (*Spermophilus parryii*; Pearse and Weinstein 1988; Mishler and Simeone 2004; InterGroup Consultants Ltd. 2009; Tr'ondëk Hwëch'in 2012a, 2012b; Bates and DeRoy 2014; Dobrowolsky 2014). Many of these species are reported to have been previously and/or currently harvested within the Coffee Creek area and other parts of the proposed Project footprint.

Additionally, Wildlife and Wildlife Habitat was selected as a VC due to the presence of several wildlife species within the Project area that are identified as species at risk, and pursuant to the federal *Species at Risk Act* (SARA), subsection 79, must be considered in an assessment of Project-related effects. For instance, two Caribou herds are known to interact with the Project, one of which is identified by the COSEWIC and the SARA as Special Concern. Caribou may show behavioral changes in response to Project disturbances and be affected through habitat loss from clearing activities within the Project footprint.

Wildlife is valued by Yukoners and has been included in all environmental and socio-economic effects assessment for proposed mines in Yukon and elsewhere in Canada where wildlife are known to interact and potentially be adversely affected by industrial activity.

1.2.1 CANDIDATE VCS

Wildlife and Wildlife Habitat was identified as a VC for the reasons discussed above in issues scoping and because the Project occurs in an area where wildlife is known to occur. There are distinct interactions between the Project and Wildlife and Wildlife Habitat, particularly habitat loss from clearing required for the Project footprint and reduced habitat effectiveness due to sensory disturbance from Project activities. The Project's potential effects on Wildlife and Wildlife Habitat can be measured and there are distinct pathways of effects (**Table 1.2-1**). There are also protection measures and guidelines in place to protect Wildlife and Wildlife Habitat in Yukon (relevant measures are described further in **Section 3.1**). An assessment on the effects on Wildlife and Wildlife Habitat supports information needs for the assessment of Socio-economic effects (e.g., **Appendix 18-B, 21-A, 24-A, 25-A**).

Table 1.2-1 Candidate Valued Components for Wildlife and Wildlife Habitat – Evaluation Summary

Candidate VC	Project Interaction			Third Party Input		Supports the Assessment of Which Other VC?	Selected as a VC?	Decision Rationale
	Interaction?	Project Phase / Project Component / Activity	Nature of Interaction	Source	Input			
Wildlife and Wildlife Habitat	Yes	Construction, Operation, Reclamation and Closure, Post-closure	Land clearing and grubbing causing habitat loss and mortality risk and Project activities causing reduced habitat effectiveness and mortality risk from vehicle collisions	YESAB guidance documents, YG, TH, EC	Concerns regarding risks to various wildlife species and habitat including species at risk	**Section 21.0 Social Economy Assessment; Section 24.0 Land and Resource Assessment; Section 25.0 Community Health and Well-being Assessment**	Yes	The type of Project-related effect will be similar for all Wildlife and Wildlife Habitat and this VC encompasses several wildlife species identified by third party input.
Fortymile Caribou herd	Yes	Construction, Operation, Reclamation and Closure, Post-closure	Land clearing and grubbing causing winter habitat loss and mortality risk and Project activities causing reduced habitat effectiveness and mortality risk from vehicle collisions and contaminants uptake from Mine Site attractants	YG, TH, YESAB	First Nations have a long-established voluntary harvest restriction on Fortymile Caribou to allow for population recovery. YG concerns about effects on Yukon habitat. Based on other YESAB decisions, YESAB concerned about effects on migratory movements.	**Section 21.0 Social Economy Assessment; Section 24.0 Land and Resource Assessment; Section 25.0 Community Health and Well-being Assessment**	No	Fortymile Caribou herd identified as a subcomponent for a detailed effects assessment and discussion.
Klaza Caribou herd	Yes	Construction, Operation, Reclamation and Closure	Land clearing and grubbing causing year-round habitat loss. Project activities causing reduced habitat effectiveness in adjacent habitat.	YG, TH	Concern over Klaza Caribou identified in the proposed Casino Project.	None	No	Klaza Caribou herd identified as a subcomponent for a detailed effects assessment and discussion.
Nelchina Caribou herd	No	n/a	n/a	YG	General interest	None	No	The Nelchina Caribou herd range does not overlap the Project footprint; however, collar data shows limited overlap with the baseline regional study area. If present, Nelchina Caribou are only expected to interact with the Project in the winter infrequently and in low numbers. Habitat use by Nelchina Caribou is similar to Fortymile Caribou and the assessment of Fortymile Caribou addresses all of the potential interactions that Nelchina Caribou would encounter. Mitigation for Fortymile Caribou will mitigate any potential effects to Nelchina Caribou.
Moose	Yes	Construction, Operation, Reclamation and Closure	Land clearing and grubbing causing year-round habitat loss. Project activities causing reduced habitat effectiveness in adjacent habitat.	YG, TH	Concerns regarding risk of increased harvest and predation due to road access. YG identified a concern about potential project effects on known/suspected concentration area of post-rut moose.	**Section 21.0 Social Economy Assessment; Section 24.0 Land and Resource Assessment; Section 25.0 Community Health and Well-being Assessment**	No	Moose identified as a subcomponent for a detailed effects assessment and discussion.
Thinhorn Sheep	Yes	Construction, Operation, Reclamation and Closure	Sensory disturbance/mortality risk from the NAR through Ballarat Creek and aircraft overflights of known areas of distribution.	TH, YG	Identified by TH as concern in engagement meetings, and information requests from First Nations (FNs) on other YESAB submissions suggest concerns about Sheep.	**Section 21.0 Social Economy Assessment; Section 24.0 Land and Resource Assessment; Section 25.0 Community Health and Well-being Assessment**	No	Thinhorn Sheep identified as a subcomponent for a detailed effects assessment and discussion

Candidate VC	Project Interaction			Third Party Input		Supports the Assessment of Which Other VC?	Selected as a VC?	Decision Rationale
	Interaction?	Project Phase / Project Component / Activity	Nature of Interaction	Source	Input			
Mule Deer	Yes	Construction, Operation, Reclamation and Closure, Post-closure	Land clearing and grubbing causing year-round habitat loss. Project activities causing reduced habitat effectiveness in adjacent habitat.	YG	General interest	None	No	Mule Deer are present in the vicinity of the Project in small numbers, although populations may be increasing in the area (Interview 14, Pers. Comm. 2016). Deer in the RAA are generally associated with steep grassy slopes along the major river and creek valleys. Project interaction with these habitats is expected to be very limited. Along the Yukon River, Thinhorn Sheep often use the same slopes, although Sheep are often found in the higher and more rugged portions of the slopes; regardless, mitigation measures for the protection of Thinhorn Sheep are expected to also mitigate effects to Mule Deer. No concerns about Project-related effects on mule deer were raised during Project consultation.
Species at risk	Yes	Construction, Operation, Reclamation and Closure. Post-Closure	Land clearing and grubbing causing habitat loss. Project activities causing reduced habitat effectiveness in adjacent habitat.	EC,SARA	Under SARA s.79(2), environmental assessments conducted under YESAA must identify any species at risk or critical habitat that is likely to be affected, and "…*must identify the adverse effects of the project on the listed wildlife species and its critical habitat and, if the project is carried out, must ensure that measures are taken to avoid or lessen those effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategy and action plans*"	None	No	Species at risk that are likely to interact with the Project are treated as individual subcomponents, not as a "group"
Grizzly Bear	Yes	Construction, Operation, Reclamation and Closure	Land clearing and grubbing causing habitat loss. Project activities causing reduced habitat effectiveness in adjacent habitat.	YG	Information requests on other YESAB submissions show YG's interest in including Grizzly Bear in mining effects assessments.	None	No	Grizzly Bear identified as a subcomponent for a detailed effects assessment and discussion
Black Bear	Yes	Construction, Operation	Increased bear/human encounters on Project site	YG	Concerns about Project-related effects on Black Bear were generally related to the potential for increased mortality, particularly as a result of bears becoming attracted and/or habituated to Project infrastructure and activities	None	No	Black Bear are relatively common in the area and can be found in a wide range of habitat types throughout the RAA. The species is not considered a Species at Risk, and is harvested in relatively low numbers within the RAA (Meister, Pers. Comm. 2016). During Project engagement meetings, concerns around Project-related effects on Black Bear were generally related to the potential for increased mortality, particularly as a result of bears becoming attracted and/or habituated to Project infrastructure/activities (Maraj, Pers. Comm. 2016). Several mitigation measures will be developed to minimize the potential for Black Bear mortality including a detailed waste management plan, a wildlife awareness / employee orientation program, wildlife encounter protocols, and construction set-back distances around active den sites. Additionally, Project monitoring will include regular surveillance and documentation of waste disposal sites, any Project-related mortality and wildlife observations (refer to the WPP, **Appendix 31-F**).

Candidate VC	Project Interaction			Third Party Input		Supports the Assessment of Which Other VC?	Selected as a VC?	Decision Rationale
	Interaction?	Project Phase / Project Component / Activity	Nature of Interaction	Source	Input			
Gray Wolf	Yes	Construction, Operation, Reclamation and Closure	Wolf attraction to site infrastructure, use of roads, disturbance of den sites.	TH, YG	During Project consultation, concerns expressed regarding wolves were not in relation to negative effects of the Project on Gray Wolves, but rather, how wolves may interact with the Project to increase their predation of prey species within the Project area.	None	No	Wolves are not considered a Species at Risk and are currently harvested in the RAA (Meister, Pers. Comm. 2016). Therefore, wolves were not selected as a VC subcomponent; however, the potential for elevated predation rates as a result of Project interactions was assessed as a Subject of Note (**Section 4.5.2**) and a monitoring program looking at wolf use of local roads was initiated during baseline studies and will continue through construction and at least the first few years of operations (refer to the WPP, **Appendix 31-F**).
Coyote/ Red Fox/ Canada Lynx	Yes	Construction, Operation, Reclamation and Closure	Attraction to site infrastructure, use of roads, disturbance of den sites.	TH	Concerns about Project effects on trapper resources.	**Section 21.0 Social Economy Assessment; Section 24.0 Land and Resource Assessment; Section 25.0 Community Health and Well-being Assessment**	No	Several larger furbearers are present in the Project area. None of these species are considered Species at Risk and all harvested in the Project RAA both currently (Interview 14, Pers. Comm. 2016; Interview 15, Pers. Comm. 2016; Meister, Pers. Comm. 2016) and historically (Tr'ondëk Hwëch'in 2012a; Dobrowolsky 2014). During Project consultation, concerns were raised by the TH TWG (Pers. Comm. 2016) about potential Project effects to trapped species, including the potential risk of Mine Site attractants and habituation of some of these species. While these species were not selected for assessment as a VC Subcomponent, mitigation measures described above for Grizzly and Black Bear (e.g. waste management, wildlife awareness training etc.) should minimize the potential for increased mortality as a result of attraction to/habituation of Project infrastructure. Buildings will also be skirted to the ground to discourage wildlife access under buildings and a no-feeding policy will be strictly enforced (refer to the WPP, **Appendix 31-F**).
Wolverine	Yes	Construction, Operation, Reclamation and Closure	Land clearing and grubbing potential risk of den or den habitat loss. Project activities causing reduced habitat effectiveness in adjacent habitat.	TH, YG	Information requests made through other YESAB submissions suggest concerns about wolverine den habitat.	None	No	Wolverine identified as a subcomponent for a detailed effects assessment and discussion
American Marten (and other economic furbearing species)	Yes	Construction, Operation, Reclamation and Closure	Land clearing and grubbing potential risk of habitat loss. Project activities causing reduced habitat effectiveness in adjacent habitat.	TH	Concerns about Project effects on trapper resources.	**Section 21.0 Social Economy Assessment; Section 24.0 Land and Resource Assessment; Section 25.0 Community Health and Well-being Assessment**	No	American Marten, American Mink, and weasels were documented during Project baseline studies. None of these species are considered Species at Risk and are all harvested in the Project RAA both currently (Interview 14, Pers. Comm. 2016; Interview 15, Pers. Comm. 2016; Meister, Pers. Comm. 2016) and historically (Tr'ondëk Hwëch'in 2012a; Dobrowolsky 2014). During Project consultation, concerns were raised by the TH TWG (Pers. Comm. 2016) about potential Project effects on trapped species. Low probability habitat use in Mine Site, limited disturbance to habitat along NAR. Marginal information gain by assessing the species individually.

Candidate VC	Project Interaction			Third Party Input		Supports the Assessment of Which Other VC?	Selected as a VC?	Decision Rationale
	Interaction?	Project Phase / Project Component / Activity	Nature of Interaction	Source	Input			
Aquatic Mammals (Beaver, Muskrat, River Otter)	Yes	Construction, Operation	Limited clearing adjacent to open wetland habitats	TH	General concern about effects to aquatic mammals	**Section 21.0 Social Economy Assessment; Section 24.0 Land and Resource Assessment; Section 25.0 Community Health and Well-being Assessment**	No	Beaver, Muskrat, and River Otter were all documented within the Project area during baseline studies. None of these species are considered Species at Risk, but all are currently harvested within the RAA (Interview 14, Pers. Comm. 2016; Interview 15, Pers. Comm. 2016; Meister, Pers. Comm. 2016) and according to TK have been harvested in the area for decades (Tr'ondëk Hwëch'in 2012a; Dobrowolsky 2014). Concerns about Project effects to aquatic mammals were raised by the TH TWG (Pers. Comm. 2016). However, Project interactions with suitable habitats for aquatic mammals. Project effects to aquatic mammals will be managed through mitigations for silt and erosion control, water quality, and fish and aquatic resources.
Little Brown Myotis	Potential	Construction, Operation	Potential roost habitat lost to Project footprint. Land clearing and grubbing potential risk of roost habitat loss.	Previous YESAB reviews, EC	Previous YESB reviews (e.g., Casino Project) and relatively recent SARA listing of Little Brown Myotis demanded an assessment of Project effects specifically for that species	None	No	Little Brown Myotis identified as a subcomponent for a detailed effects assessment and discussion, primarily because they are a SARA Species at Risk.
Collared Pika	No	Construction, Operation	Land clearing and grubbing potential risk of habitat loss. Project activities causing reduced habitat effectiveness in adjacent habitat.	TH, YG, EC	Concerns about potential Project effects to Collared Pika	None	No	Collared Pika are considered a Species at Risk (Special Concern; COSEWIC 2011) and were raised as a concern for the Project by Environment Canada (Pers. Comm. 2015) and Environment Yukon (Suitor 2015). However, baseline surveys in 2014 and 2015 did not locate Pika within 10 km of the Project footprint, and suitable habitat is limited to a few small isolated patches. Interaction with the Project is not expected.
Other small mammals (Porcupine, Snowshoe Hare, Squirrels, Mice, Voles)	Yes	Construction, Operation, Closure	Land clearing and grubbing potential risk of habitat loss. Project activities causing reduced habitat effectiveness in adjacent habitat.	TH	General interest, no specific concerns identified	**Section 21.0 Social Economy Assessment; Section 24.0 Land and Resource Assessment; Section 25.0 Community Health and Well-being Assessment**	No	Several small mammal species have been documented in the Project area — none of these species are considered Species at Risk, although some have been previously and/or currently harvested by local First Nations (Dawson Indian Band 1988; Mishler & Simeone 2004; Leary 2009; Tr'ondëk Hwëch'in 2012a). No concerns about Project effects to small mammals were raised during Project consultation. Habitat effects on these species can be approximated through quantification of general habitat loss, and mitigation to minimize Project footprint will help limit effects. Project monitoring for trace metals includes monitoring of small mammals as indicated by vegetation sampling (refer to the WPP, **Appendix 31-F**).
Amphibians	Yes	Construction, Operation, Reclamation and Closure	Limited clearing adjacent to open wetland habitats	n/a	n/a	None	No	The only amphibian species expected in the Project area is the Wood Frog, which is widespread throughout the Yukon and not considered a conservation concern federally or territorially. During Project consultation, no concerns were raised regarding amphibians. Wood Frogs breed in clear, shallow ponds — this habitat type is limited within the Project footprint. However, mitigation measures for silt and erosion control, and other mitigation for water quality will mitigate Project effects amphibians.

Candidate VC	Project Interaction			Third Party Input		Supports the Assessment of Which Other VC?	Selected as a VC?	Decision Rationale
	Interaction?	Project Phase / Project Component / Activity	Nature of Interaction	Source	Input			
Terrestrial Insects	Yes	Construction, Operation, Reclamation and Closure	Land clearing and grubbing potential risk of habitat loss.	YESAB	Mentioned in draft YESAB guidelines	n/a	No	Terrestrial insects are likely distributed throughout the Project area, although distribution and abundance are unknown. Based on known ranges, no species listed under SARA have potential to be found in the Project area. No concerns regarding terrestrial insects were raised during Project consultation. However, limiting the size of the Project footprint and management of aquatic resources will mitigate effects on terrestrial insects.

1.2.2 WILDLIFE AND WILDLIFE HABITAT SUBCOMPONENTS

First Nations engaged in Project scoping communicated concerns about the Project's potential effects on local wildlife populations. The Tr'ondëk Hwëch'in told the Proponent that although they had specific concerns about some key wildlife species and habitats, they noted that all species and habitats play an important role in ecological function, and it is therefore important to the Proponent to include Wildlife and Wildlife Habitat in the Project effects assessment.

Assessment of Project interactions with Wildlife and Wildlife Habitat was based on species- or population-specific analyses, including habitat requirements, movement patterns, mortality risks, and sensitivity to disturbance. All wildlife species that have the potential to interact with the Project were considered during the initial scoping phase. However, to focus the wildlife effects assessment, several criteria were used to identify subcomponents (e.g., species or populations). Key criteria used to select subcomponents included:

- Species or populations with a clear interaction within the Project footprint — for example, the winter range of the expanding Fortymile Caribou herd clearly overlaps the Project footprint, and Caribou will likely interact with Project activities
- Species that are known to be sensitive to disturbance — for example, Grizzly Bear (*Ursus arctos*) are considered to be particularly sensitive to disturbance, and human interaction with Grizzly Bear can often be detrimental to individual bears
- Habitat specialists — for example, Thinhorn Sheep use cliff-type habitat with access to suitable escape habitat, potentially near Project infrastructure
- Species that are culturally important — for example, Moose are important to local communities as a food source
- Species at Risk — the Project's effects assessment must identify the adverse effects on species listed in SARA that are likely to occur in the Project area. This assessment also considers species at risk identified by COSEWIC that may not yet be listed under SAR, and
- Species identified in engagement meetings or otherwise documented as a concern.

Specific wildlife species and populations were identified through consultation and engagement with TH, other First Nations, government regulators, and/or other stakeholders, and included the following that are included as subcomponents in this assessment (**Table 1.2-2**):

Fortymile and Klaza Caribou — For Caribou, two separate subcomponents were selected for assessment — the Fortymile Caribou herd, a migratory herd that winters in Yukon, and the Klaza Caribou herd (*Rangifer tarandus caribou*), a non-migratory herd that may be found in the vicinity of the Project using year-round habitat. Klaza Caribou is a herd within the Northern Mountain Caribou Population of woodland Caribou which is listed in the SARA as a species of Special Concern.

Moose — Moose were identified in consultation meetings with First Nations and regulators as important. They were identified in traditional knowledge studies by multiple First Nations as a species of particularimportance to the communities. Moose are a common harvest species.

Thinhorn Sheep — Thinhorn Sheep were identified during engagement meetings and are a species of cultural importance. They occur in low densities in the vicinity of the Project.

Grizzly Bear — Grizzly Bear are identified by COSEWIC as Special Concern, but is not listed in the SARA. It was identified as being of interest in engagement meetings with First Nations and YG. It is a species that is recognized as being sensitive to human disturbance.

Wolverine — Wolverine are identified by COSEWIC as Special Concern, but is not listed in the SARA. It is a species trapped by First Nations and community members. It was identified in engagement meetings and by YG.

Little Brown Myotis (*Myotis lucifugus*) — This bat species is endangered due to a fungal disease, white nose syndrome (COSEWIC 2013), and is listed in Schedule 1 of SARA.

The potential effects to these species are considered representative of the potential effects to all wildlife species in the region with similar habitat requirements, and the effects assessment conducted for those subcomponents represents the likely range of potential Project effects on wildlife as a whole. Species that are not included as subcomponents were those that, while they may be found in the broader Project area, are unlikely to interact with the Project in substantial numbers, are found only in very low densities, are not Species at Risk, were not identified as a concern by First Nations or regulators, or are generally numerous and not susceptible to anthropogenic disturbances.

Issues identified during scoping that do not necessarily fit within the format used in this effects assessment, like site-specific habitat features such as mineral licks and a discussion about potential effects on predator/prey dynamics, are discussed in **Section 4.5** — Subjects of Note.

Table 1.2-2 Wildlife and Wildlife Habitat Subcomponents

Subcomponent	Rationale
Fortymile Caribou	The Fortymile Caribou herd is a migratory Caribou herd, recently returned to the Project area after decades of recovery from a population low that caused the herd to abandon its Yukon range. Historically the herd was a very important source of food and clothing for local First Nations; however, in recent decades the herd has been the target of international recovery efforts including a closure of Yukon licensed harvest, and a voluntary harvest closure by the Tr'ondëk Hwëch'in. During Project consultation, the continued recovery of the Fortymile Caribou herd was identified as a key concern by both Tr'ondëk Hwëch'in (Becker, c 2016; TH TWG, Pers. Comm. 2016) and Environment Yukon (Suitor 2015). Since the fall of 2013, the Fortymile Caribou herd has been seasonally present in the baseline regional study area in substantial numbers for two of three winters indicating the potential for Project interaction.
Klaza Caribou	The Klaza Caribou herd is a resident herd of Woodland Caribou whose annual range overlaps the southern-most sections of the proposed Project. The Klaza Caribou are members of the northern mountain population (NMP) of Woodland Caribou and are considered a Species at Risk (Special Concern) and listed on Schedule 1 of SARA (2016). Potential Project effects to Klaza Caribou were raised as a concern during Project consultation (Hegel, Pers. Comm. 2016), although it was noted that the Project is located outside of the herd's late winter range.
Moose	Moose were one of the key species identified during engagement meetings as a concern for the Project. Moose are the primary harvest species in the region for both First Nations (Calliou Group 2012; Becker, Pers. Comm. 2016) and non-First Nations residents (Suitor 2015; Meister, Pers. Comm. 2016), and the ability to harvest Moose is believed to be essential to preserving the health of First Nations people, as well as the "traditional lifestyles and identities of individual TH citizens and the community as a whole" (Tr'ondëk Hwëch'in 2012b). Present mortality rates (mostly as a result of hunting) are considered at or near the sustainable limit for parts of the RAA (Suitor 2015) leading to concerns about increased harvest as a result of the Project, as well as other potential Project–related effects on habitat and mortality.
Thinhorn Sheep	A small number of Thinhorn Sheep have been identified using the steep rocky bluffs along the Yukon River. Thinhorn Sheep are not considered to be a Species at Risk either federally or territorially; however, during Project consultation, concerns were expressed by both Environment Yukon (Suitor 2015; Hegel, Pers. Comm. 2016) and Tr'ondëk Hwëch'in (Ayoub, Pers. Comm. 2016) about potential Project effects on Thinhorn Sheep, given the small numbers observed in the Project area. The proposed Northern Access Route may transect Thinhorn Sheep movement corridors along the north side of the Yukon River.
Grizzly Bear	Baseline studies documented Grizzly Bear in low densities throughout the Project area. Grizzly Bear are considered a Species at Risk (Special Concern; COSEWIC 2012) but are not listed on Schedule 1 of SARA (2016). Grizzly bears are often sensitive to human presence, and anthropogenic mortality can have important influences on occupancy and functional habitat loss (COSEWIC 2012). Grizzly Bear harvest does occur in the RAA; although in relatively low numbers. During Project consultation, concerns about Project-related effects on Grizzly Bear were raised by Environment Yukon, mostly in relation to increased mortality — the Project area overlaps a region with a history of adverse human-bear interactions. Additional concerns about effects to habitat, particularly denning habitat, were also raised (Suitor 2015; Maraj, Pers. Comm. 2016).
Wolverine	Wolverine is considered a Species at Risk (Special Concern; COSEWIC 2014), although is not listed under Schedule 1 of SARA (2016). The species is currently trapped within the RAA (Interview 15, Pers. Comm. 2016; Meister, Pers. Comm. 2016) and according to TK has been harvested in the area for decades (Tr'ondëk Hwëch'in 2012a; Bates and DeRoy 2014). Project baseline surveys documented Wolverine on several occasions. During the baseline data collection period, Environment Yukon expressed concerns about potential Project effects on Wolverine (Suitor 2015) and information requests made during other YESAB ExComm submissions suggest concerns about Wolverine denning habitat (e.g., YESAB 2015).
Little Brown Myotis	Little Brown Myotis is a Species at Risk (Endangered; Schedule 1; SARA 2016). Project baseline surveys indicated presence at lower elevations along the proposed NAR.

1.2.3 WILDLIFE AND WILDLIFE HABITAT INDICATORS

Indicators are quantitative or qualitative measures that describe existing subcomponent conditions and trends. Indicators are used to evaluate potential Project-related and cumulative effects on each subcomponent. The indicators identified for each Wildlife and Wildlife Habitat subcomponent are summarized in **Table 1.2-3.**

For some subcomponents, indicators are quantified and discussed in detail and for other subcomponents the indicators are discussed qualitatively — the level of detail is dependent on level of concern expressed in engagement meetings, information available in the literature, or availability of baseline data.

Table 1.2-3 Indicators for Wildlife and Wildlife Habitat Subcomponents

Indicator	Rationale for Selection
Fortymile Caribou	
Habitat loss and reduced habitat effectiveness: Winter habitat (km²)	The Project is within the winter range of the expanding Fortymile Caribou herd (FMCH). The Project's footprint results in habitat loss, and Project-related sensory disturbances result in reduced effectiveness adjacent to the footprint. The effect on winter habitat is the sum of direct habitat loss and reduced habitat effectiveness.
Mortality risk: (number of animals per year additive mortality)	There is the potential for vehicle–wildlife collisions, and improved road access could facilitate increased harvester access through a portion of the herd's winter range. Mechanisms of additive mortality can adversely affect population recovery and growth.
Alteration to movement	The FMCH will continue to access portions of their historical winter range. Project infrastructure may have adverse effects on natural movement patterns.
Klaza Caribou	
Habitat loss and reduced habitat effectiveness: Year-round habitat (km²)	The Project is within the annual range of the Klaza Caribou herd (KCH). The Project's footprint results in habitat loss and Project-related sensory disturbances result in reduced effectiveness adjacent to the footprint. The effect on year-round habitat is the sum of habitat loss and reduced habitat effectiveness.
Moose	
Habitat loss and reduced habitat effectiveness: Late winter habitat (km²)	The Project is within Moose winter range. The Project's footprint results in habitat loss, and Project-related sensory disturbances results in reduced effectiveness adjacent to the footprint. The effect on late winter habitat is the sum of habitat loss and reduced habitat effectiveness.
Mortality risk: (number of animals per year additive mortality)	There is the potential for vehicle-wildlife collisions, and improved road access could facilitate increased harvester access through portions of Game Management Subzones where harvest occurs. Mechanisms of additive mortality can adversely affect Moose populations.
Thinhorn Sheep	
Habitat loss and reduced habitat effectiveness: Year-round habitat (km²)	The NAR traverses between sites known to be used by Thinhorn Sheep. The footprint and sensory disturbances may have adverse effects on habitat. The effect on habitat is the sum of habitat loss and reduced habitat effectiveness.
Alteration to movement	The NAR traverses between sites known to be used by Thinhorn Sheep. Sensory disturbances and resulting individual responses may have adverse effects on movement between habitat patches.

Indicator	Rationale for Selection
Grizzly Bear	
Habitat loss and reduced habitat effectiveness: Denning, security, linkage and foraging habitat (ha or km²)	Cumulative human presence, including that of the Coffee Project, could have an adverse effect on security, linkage, foraging and denning habitat.
Mortality risk: (number of animals per year additive mortality)	Increased human presence could lead to increased human-Grizzly Bear encounters. Problem bear kills could have an adverse effect on Grizzly Bear population.
Wolverine	
Habitat loss and reduced habitat effectiveness: Denning habitat (km²)	Regulator concern. The Project's footprint results in habitat loss, and Project-related sensory disturbances results in reduced effectiveness adjacent to the footprint. The effect on denning habitat is the sum of habitat loss and reduced habitat effectiveness.
Mortality risk: (number of animals per year additive mortality)	Increased human presence could lead to increased human-Wolverine encounters. Problem animal kills could have an adverse effect on Wolverine population.
Little Brown Myotis	
Habitat loss and reduced habitat effectiveness: Roost habitat (km²)	The Project's potential disturbance to roost habitat is likely the only interaction the Project has with the potential for adverse effects. The Project's footprint results in habitat loss and Project-related sensory disturbances results in reduced effectiveness adjacent to the footprint. The effect on roosting habitat is the sum of habitat loss and reduced habitat effectiveness.

1.3 ASSESSMENT BOUNDARIES

The spatial and temporal boundaries for the Wildlife and Wildlife Habitat effects assessment encompass the areas within, and times during which, the Project is expected to interact with Wildlife and Wildlife Habitat. The administrative and technical boundaries represent any constraints that may be placed on the effects assessment due to political, social, and economic realities (i.e., administrative boundaries), or limitations in predicting or measuring changes (i.e., technical boundaries).

1.3.1 SPATIAL BOUNDARIES

The **Project footprint** is the area in which ground will be disturbed and Project activities will occur, as described fully in **Section 2.1** of the Project Description.

There are several **Zones of Influence** (**ZOI**) that are used to assess the effect of reduced habitat effectiveness due to sensory disturbance for most wildlife subcomponents. The ZOI is the area where the effectiveness of habitat may be reduced and does not result in lost or inaccessible habitat, but reduced probability of use of a habitat patch while the influence (i.e. activity) remains. **Section 2.0** provides further information the ZOI approach used for the effects assessment.

The **Regional Study Area** (**RSA**) was used for baseline studies to assess the abundance and distribution of most large wildlife species, including Caribou, Moose, Thinhorn Sheep, Mule Deer, Grizzly Bear, Black Bear, Wolf, Wolverine, and other furbearers, in the Project area. The RSA was delineated to include any game management subzone (GMS) that intersects or proximal to the Project footprint, including the NAR. The Regional Study Area is described further in the Wildlife Baseline Report (**Appendix 16-A**).

There are several **Regional Assessment Areas** (**RAAs**) used for the Wildlife and Wildlife Habitat effects assessment. The assessment areas are based on areas biologically relevant to the species or species group being assessed. Assessment areas for each subcomponent are described in **Table 1.3-1**, illustrated in **Figure 1.3-1**, and summarized with more details on the biological rationale of the areas below.

- Project and cumulative effects on the FMCH are characterized within the **Fortymile Caribou RAA** (**FC-RAA**). The FC-RAA is based on a polygon provided by Environment Yukon (M. Suitor, Pers. Comm. 17 September 2015) that outlines the area in Yukon where the FMCH can reasonably be expected to use within the coming decade. It is based on the historic distribution of the herd, the 2013–2014 distribution, and what Environment Yukon considers to be expansion habitat adjacent to those locations. The FC-RAA encompasses all areas that the herd has used since returning to Yukon (2002 to spring 2016), and additional habitats to the west which may be used should the herd continue to expand its range. Compared to the historic range (e.g., McDonald and Cooley 2004), the FC-RAA does not go as far south and east, but does include area to the north (Tombstone-Ogilvie) based on the 2013 FMCH movement.
- Project and cumulative effects on the KCH are characterized within the **Klaza Caribou RAA** (**KC-RAA**). The area is biologically relevant to characterizing effects on the KCH because it encompasses the Caribou herd's annual range (shapefile provided by Environment Yukon).
- Moose, Grizzly Bear, Wolverine and Little Brown Myotis Project and cumulative effects are characterized within the **Wildlife RAA** (**W-RAA**). The W-RAA was delineated to include GMSs within Game Management Areas (GMAs) that intersect or are proximate to the Project footprint, including the NAR. Game Management Areas are legal boundaries that define an area within which big game management objectives can be met through the setting of area-specific regulations. In other words, GMAs are used to manage Yukon wildlife species (described further in **Section 3.1.2.2**). The W-RAA was also applied to Little Brown Myotis. Little Brown Myotis may travel long distances between roosting and foraging areas, typically flying more than 2 km between roosting and foraging sites, sometimes up to 5 to 8 km (Holroyd et al. 2016). Given the potential area required to contain both suitable foraging and roosting habitat for an individual bat or colony, the W-RAA was considered an appropriate size assessment area for Little Brown Myotis at the regional level.
- Thinhorn Sheep Project and cumulative effects are characterized within the **Thinhorn Sheep RAA** (**TS-RAA**). The TS-RAA includes a 10 km buffer on either side of the Yukon River, and encompasses the White River and Minto Wildlife Key Areas (WKAs). The TS-RAA includes known Sheep occurrence areas to the east and west of the Project along the Yukon River, and excludes the northern and southern portions of the wildlife RSA where Sheep were not observed.

Table 1.3-1 Spatial Boundaries Used for the Wildlife and Wildlife Habitat Project and Cumulative Effects Assessment

Spatial Boundary	Description of Assessment Area
Project footprint	The area where ground will be disturbed and Project activities will occur, as described fully in **Section 2.1.2** of the Project Description.
Zone of Influence (ZOI)	The ZOI is characterized as an area defined by some distance buffer from the Project footprint to assess the effect of reduced habitat effectiveness due to sensory disturbance for most wildlife subcomponents. ZOIs are specific to each subcomponent and are based on the best available information, and described where applicable for each subcomponent.
Fortymile Caribou	
Fortymile Caribou RAA (FC-RAA)	Outlines the area in Yukon where the FMCH can reasonably be expected to use within the coming decade. Polygon provided by Environment Yukon.
Klaza Caribou	
Klaza Caribou RAA (KC-RAA)	Annual herd range identified by Environment Yukon.
Moose, Grizzly Bear, Wolverine, Little Brown Myotis	
Wildlife RAA (W-RAA)	Includes GMSs within GMAs that intersects or are proximal to the Project footprint (Mine Site and NAR). Bounded by biophysical features and overall assessment area includes representation of habitat available to myotis for foraging and roosting requisites.
Thinhorn Sheep	
Thinhorn Sheep RAA (TS-RAA)	Includes a 10 km buffer on either side of the Yukon River, and encompasses the White River and Minto Wildlife Key Areas (WKAs).

1.3.2 TEMPORAL BOUNDARIES

The temporal characteristics of the Project's Construction, Operation, Reclamation and Closure, and Post-closure phases are described in **Volume I**, **Section 2.0 Project Description**. The temporal boundaries established for the assessment of Project effects on Wildlife encompass these Project phases. Potential Project effects on wildlife subcomponents are assessed for the Project at the maximum disturbance level. Maximum disturbance includes the most extensive footprint disturbance (i.e. habitat loss) and sensory disturbance (i.e. reduced habitat effectiveness) as a result of Project activities.

Temporal boundaries related to seasonal movement and habitat use are identified for Fortymile Caribou, Grizzly Bear, and Wolverine as follows:

- **Fortymile Caribou** — October through April. Typically, the Fortymile Caribou only occupy the Yukon during winter.
- **Grizzly Bear denning** — September 15 to June 15. The main denning season for Grizzly Bear in Yukon is from October through April or May, but denning can begin as early as mid-September and extend until as late as mid-June if snow conditions are suitable (YG 2014).
- **Wolverine denning** — February through May, which is the typical denning season for Wolverine (Magoun and Copeland 1998).

1.3.3 ADMINISTRATIVE BOUNDARIES

The Yukon-Alaska border is an administrative border that has relevance to this assessment, particularly for the Fortymile Caribou herd. Project-related effects are assessed only within Yukon; therefore no transboundary effects are assessed.

1.3.4 TECHNICAL BOUNDARIES

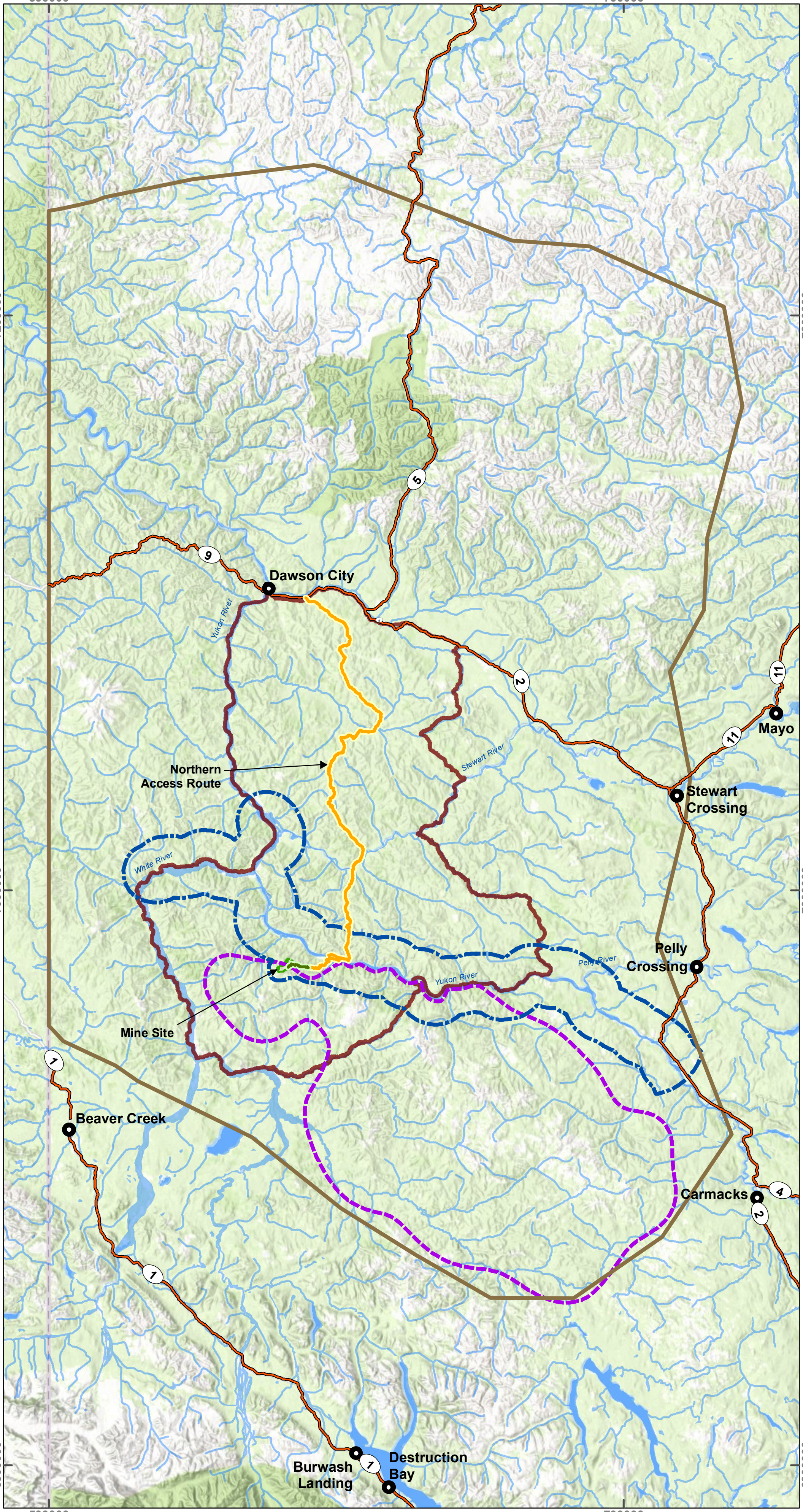
Several constraints were identified that may impose limitations in identifying or measuring potential effects to Wildlife and Wildlife Habitat within the RAAs due to the potential Project-related interactions. These constraints include the following:

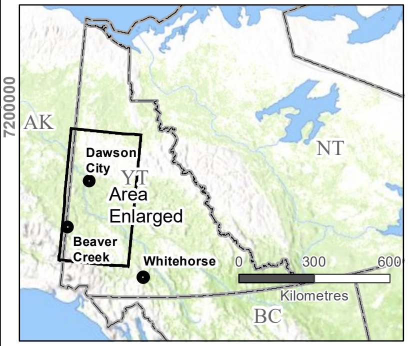
- Information on unlicensed harvest is not available. When assessing mortality risks, only licensed harvest data are used which likely underestimates actual harvest rates.
- Accurate population density estimates for many species, such as Thinhorn Sheep, Grizzly Bear, Wolverine, and Little Brown Myotis, are not available.
- Seasonal and annual distribution information for many species is lacking.
- For Thinhorn Sheep, there is very little information available on the distribution of the Yukon River population and no regional information on population structure for Yukon River Sheep.
- A comparison of habitat affected by the Project to the habitat that is available regionally is limited by the lack of region-level ecosystem mapping. While detailed ecosystem mapping was collected near the Mine Site and NAR (see Vegetation Baseline Report, **Appendix 15-A**), that level of detail was not available regionally to characterize wildlife habitats. Alternative, species-specific, methods of habitat classification were employed to characterize respective regional contexts.

Limited information or knowledge regarding species ranges, population numbers, habitat requirements, and responses to disturbance(s) at the species and individual level could lead to uncertainties regarding the extent of potential Project-related effects and the overall implications at the population level. Challenges associated with surveying difficult terrain for wildlife presence or locating inconspicuous animals, could lead to data gaps for certain subcomponents (e.g., specific locations of used Grizzly Bear dens). Using habitat suitability models may impose constraints on the effects assessment due to data limitations. The habitat suitability models were based on data available in the region, and may not represent habitat variables selected by Wildlife; therefore, it is not possible to compare amounts of suitable habitat for these subcomponents in the context of the RAAs or with respect to adjacent projects (e.g., the proposed Casino Mine Project).

COFFEE GOLD MINE

Wildlife and Wildlife Habitat Assessment Boundaries





Legend

- City/Town
- Highway
- Mine Site Access Route
- Northern Access Route
- ProjectFootprint
- Fortymile Caribou Regional Assessment Area (FC-RAA)
- Thinhorn Sheep Regional Assessment Area (TS-RAA)
- Klaza Caribou Regional Assessment Area (KC-RAA)
- Wildlife Regional Assessment Area (W-RAA)

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

1. Sources: Esri, HERE, DeLorme, increment P Corp., NPS, NRCan, Ordnance Survey, © OpenStreetMap contributors, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community
2. Study areas developed by EDI Environmental Dynamics Inc. (2014).
3. Project access and infrastructure provided by Goldcorp Inc. (2017).

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2.0 ASSESSMENT METHODS

The methods used to identify and assess potential Project-related and cumulative effects on Wildlife and Wildlife Habitat address assessment requirements identified in the YESAA and YESAB guidance documents (e.g., YESAB 2005). These methods are consistent with Environmental Assessment Best Practice Guide for Wildlife at Risk in Canada (Canadian Wildlife Service 2004), a VC-specific reference for assessment methods. The assessment of Project-related effects, cumulative effects, and effects due to accidents or malfunctions on Wildlife and Wildlife Habitat was conducted according to the methods in **Volume I, Section 5.0 Assessment Methodology**. As described in each section of the report, the assessment was informed by input provided during consultation and engagement with government agencies, affected First Nations, and the public, in addition to a review of TK, scientific and unpublished information.

The assessment of Project effects on Wildlife and Wildlife Habitat used various techniques to quantify and qualify potential Project and cumulative effects on subcomponents. For the most part, habitat availability at a regional level, and the potential Project effects on that habitat were quantifiable. Because potential changes to animal movements and risks to mortality are not as readily quantifiable as habitat loss and reduced habitat effectiveness, a qualitative assessment approach was taken for the assessment of those effects. The characteristics of potential residual effects (i.e., those remaining following the application of mitigation measures) are described and their significance and likelihood are determined based on the subcomponent-specific effects criteria and thresholds described in **Section 4.4**.

Quantifiable components include an assessment of habitat effects that consider habitat lost to the Project footprint, and reduced habitat effectiveness in adjacent habitat within a Zone of Influence (ZOI) of the Project. A ZOI was used to assess the effect of reduced habitat effectiveness due to sensory disturbance for most wildlife subcomponents. The ZOI is the area where reduced probability of use of a habitat patch occurs while the influence (i.e. activity) remains. It is often defined as the area where a statistically detectable change in animal distribution occurs relative to the distance from anthropogenic activity. The habitat within the ZOI remains, but the probability of an animal using habitat of equal quality changes as a function of distance from the infrastructure/activity. The disturbance mechanism is assumed to be a combination of sensory stimuli (e.g., response to smell, noise, vibration, human presence) and is likely specific to the animal, region, and site characteristics. The ZOIs used in this assessment are specific to each subcomponent and are based on the best available information.

The Project footprint, ZOI, and RAA layers were intersected with baseline wildlife habitat models to quantify habitat effects. This provided the area of habitat lost due to the Project footprint, the area of effective habitat reduced by sensory disturbances within the ZOI, and the area of unaffected habitat within the RAA. Grizzly Bear habitat models incorporated ZOIs as data inputs; therefore, rather than using intersections, the resultant model outputs were compared between pre- and post-Project conditions. In both methods, the affected habitat was compared to the total habitat available within the defined RAAs.

Various spatial data types were used to define habitat for Moose, Thinhorn Sheep, Wolverine, and Little Brown Myotis. Methodology on habitat models developed during baseline assessment for Moose, Thinhorn Sheep, Grizzly Bear, and Wolverine are available in the Wildlife Habitat Modelling Reports (**Appendix 16-C**). For example, the quantification of the effects on Grizzly Bear habitat followed a technique established for cumulative effects assessment (adapted from Purves and Doering (1998) and Maraj (2007)), considered existing human presence in the landscape, and estimated the Project's potential effects on Grizzly Bear security area habitat and an estimate of available denning habitat. The approach taken with respect to the individual subcomponents is described further in **Section 4.4**.

In collaboration with YG, the Proponent is contributing to the development of a winter season Resource Selection Function (RSF) habitat model for Fortymile Caribou. That model will describe habitat selection of recently collared Fortymile Caribou, and the reporting will be completed in late 2016. Until those model results are available, and in agreement with Environment Yukon, the approach taken here examines the Project effects on habitat as an overall area-based calculation that treats all habitat as equally important to Fortymile Caribou.

Mortality risk is discussed from the perspective of the probability of Project activities increasing wildlife mortality wildlife incidents, and considers, as an indirect effect, whether the Project will provide increased and unmanaged access to wildlife harvesters. Reducing the indirect mortality risk from harvester access is placed in the context of existing wildlife management practices and harvest management responsibilities, in addition to what the Proponent is able to mitigate directly on the Project site.

The assessment also considers potential alteration to movement patterns, particularly relevant as a potential effect on Fortymile Caribou and Thinhorn Sheep. The assessment for Fortymile Caribou and Thinhorn Sheep movement characterizes the species' likely nature of encounter with Project infrastructure, and the predicted movement response is based on animal behaviour literature review and knowledge of local conditions. The assessment of alteration to movement on Grizzly Bear used a quantified approach that included a model of linkage zone habitat, using methods adapted from Purves and Doering (1998).

The cumulative effects assessment focused on a quantifiable assessment of habitat effects arising from the interaction of residual Project effects and the residual effects of other past, present, and reasonably foreseeable future projects and activities within the various RAAs. Spatial footprint data and estimated ZOIs of other projects and activities were intersected with the RAAs of each subcomponent to consider the cumulative extent of a habitat effect. In the case of Grizzly Bear, the models were run with various conditions as inputs (baseline, pre-Project, post-Project) and resultant habitat effects were compared.

3.0 EXISTING CONDITIONS

This section describes the existing conditions of each subcomponent within the region surrounding the Project, including the regulatory context for Wildlife and Wildlife Habitat. The information is provided at a level of detail that establishes local context and enables reviewers to understand the potential interactions between the Project and Wildlife and Wildlife Habitat. Existing conditions are described based on available information that included the following sources:

- Federal, territorial, First Nation, and local government mandates, agreements, and interests of specific relevance to Wildlife and Wildlife Habitat, including the legislation and/or policy through which regulation and management occurs, and any associated reports or plans that are or may be developed (e.g., Recovery Strategy under SARA).
- Baseline reports describing desktop and field studies, including the collection, analysis, and documentation of data and its treatment according to appropriate territorial or federal guidelines and standards.
- Subject to any confidentiality constraints that may apply, available TK relevant to Wildlife and Wildlife Habitat. References to this information include the source and an explanation of how it informed the understanding of existing conditions.
- Scientific and other information, including existing reports in popular, grey, or published literature, databases, remote sensing imagery and data, monitoring programs, and previous environmental assessments or associated technical reports, including a discussion of the quality and relevance of the information.

3.1 REGULATORY CONTEXT

The following legislation and regulations are relevant to Project's effects assessment and mitigation and monitoring for Wildlife and Wildlife Habitat.

3.1.1 FEDERAL GOVERNMENT

3.1.1.1 Yukon Act (SC 2002, c. 7)

The *Yukon Act* gives authority to the Yukon Legislature to make laws in relation to the conservation of wildlife and its habitat within Yukon, other than in a federal conservation area. This Act prohibits the YG from making laws that limit subsistence hunting by aboriginal people on lands where Final Agreements are not in effect. Where Final Agreements are in effect, such as the Project area, the YG has the legislative authority to regulate all hunting, and must conform to the provisions of First Nation Final Agreements when addressing subsistence harvesting.

3.1.1.2 Yukon Environmental and Socio-economic Assessment Act (SC 2003, c.7)

The YESAA gives authority and rules to YESAB to administer the assessment process that applies to all lands within Yukon. It was called for in Chapter 12 of the Yukon First Nations Final Agreements and came into effect in 2003. The Board's mission is to protect the environment and social integrity of Yukon, while fostering responsible development. The YESAB information requirements and evaluation process guidelines identify the need to document abundance and distribution characteristics of major wildlife species within the region encompassing the Project, including key habitat features. Also identified in these guidelines is the inclusion of all proposed environmental protection, contingency, and monitoring plans including wildlife protection and monitoring.

3.1.1.3 Species at Risk Act (SC 2002, c.29)

The SARA implements in part Canada's obligations under the United Nations Convention of Biological Diversity. It provides for the legal protection of wildlife species and the conservation of their biological diversity. Under SARA, the COSEWIC, an independent body of experts, is responsible for identifying and assessing plant and wildlife species considered at risk, which may then qualify for legal protection and recovery under SARA. Once listed under SARA, species plans are legal requirements to secure the necessary actions for species recovery and management. The schedules of the Act were used to identify SARA listed species in the Project area that are of particular conservation concern, which may require additional levels of protection. The only species at risk in the Project area with an existing management plan is the northern mountain population (NMP) of Caribou (which includes the Klaza Caribou herd).

3.1.1.4 Canadian Wildlife Act (R.S.C., 1985, c. W-9)

The Canadian Wildlife Act allows for the creation, management and protection of wildlife areas to preserve habitats, and to permit wildlife research and interpretive activities. There are no such protected areas within the Wildlife and Wildlife Habitat RAAs.

3.1.1.5 Convention on Wetlands (Ramsar Convention, 1971)

The Convention on Wetlands commits the federal government to maintain the ecological character of wetlands of international significance and to plan for the sustainable use of all wetlands. The Federal Wetlands Policy was established in 1991 in response to Ramsar. The policy provides goals, guiding principles and strategies for conserving wetlands on federal lands and those significant to Canadians. Although the policy was considered initially in scoping, there are no wetlands of territorial importance, as defined by the Yukon Wetland Technical Committee (YWTC), within the Wildlife and Wildlife Habitat RAAs (Environment Yukon 1999).

3.1.2 TERRITORIAL GOVERNMENT

3.1.2.1 Environment Act (RSY 2002, c.50)

Yukon's *Environment Act* and regulations provide for the protection of land, water, and air. The Act applies on lands throughout Yukon, including private property, Crown lands, lands within municipal boundaries, and First Nation settlement lands where the First Nation has not developed equivalent laws. This act is primarily used for regulations related to air quality, waste, recycling, spills and contaminated sites; however, the Act also provides for natural resource planning and management, including wildlife, and conservation easements for conserving and enhancing wildlife habitats. There are currently no regulations for the protection of Wildlife and Wildlife Habitats under this act.

3.1.2.2 Wildlife Act (RSY 2002, c.229)

The Act provides rules for hunting and trapping, outfitting and guiding, licensing, enforcement, and habitat protection. It also gives authority to make various regulations. Regulations include prescribing specially protected wildlife and measures to protect, prescribing boundaries of wildlife sanctuaries (none exist in the Wildlife and Wildlife Habitat assessment areas) and measures for management, methods of hunting and trapping wildlife, licensing and permitting conditions, zoning Yukon to administer the Act, and the submission of harvest information. The Act is typically amended every 10 to 20 years while regulations can be updated annually. The Act defines "wildlife" as any vertebrate animal of any species or type that is wild by nature, and includes wildlife in captivity, but does not include fish.

Relevant to Wildlife and Wildlife Habitat, the *Wildlife Act* states that a person shall not:

- "damage or interfere with a beaver dam, or the den, lair or nest of any wildlife" (Wildlife Act 91[1])
- "harass any wildlife" (Wildlife Act 91[1]). "*A person shall be deemed to harass wildlife if the person operates a vehicle or boat in a manner that might reasonably be expected to harass any wildlife; or attempts to interfere with the movement of any wildlife across any road or watercourse*" (*Wildlife Act* 92[2] c and d).

The *Game Management Subzone Regulations* (O.I.C. 1984/108) identifies subzones within Game Management Areas (GMAs). Game Management Areas are legal boundaries that define an area within which big game management objectives can be met through the setting of area-specific regulations. In other words, GMAs are used to manage Yukon wildlife species. GMAs are a combination of Game Management Zone (GMZ or Zone) and Game Management Subzone (GMS or Subzone). There are 443 GMAs in Yukon which are grouped together into 11 zones. In general, zone boundaries follow highway centrelines and subzone boundaries follow creeks and rivers. Game Management Areas effectively delineate mountain blocks, reflecting their original use as Sheep management units. Despite this original intent, GMAs are now used to manage all species of Yukon wildlife. With the exception of National Parks, the entire Yukon is covered by GMAs. GMAs are legally defined by the 1:250,000 scale map series: reg97041 (information extracted from http://www.env.gov.yk.ca/publications-maps/geomatics/envydata-admin.php).

3.1.3 First Nation Governments

The Project is located on Crown land within the traditional territory of the TH and the asserted traditional territory of the White River First Nation (WRFN). Sections of the proposed NAR also overlap the traditional territory of the Selkirk First Nation (SFN) and the First Nation of Na-cho Nyäk Dun (FNNND).

The WRFN have not signed a Final Agreement with the Government of Canada. While the WRFN current land use of the Coffee Project area is limited, the First Nation has expressed an interest in the area for future use. The remaining three First Nations have Final Agreements negotiated with the Government of Canada. As such, boards and councils have been established under the Umbrella Final Agreement (UFA, Government of Canada 1993) and Yukon First Nation Final Agreements, which have advisory and management responsibilities related to Wildlife and Wildlife Habitat both throughout Yukon, and within specific First Nation Traditional Territories. There is First Nation representation on all of the management council and boards established through the UFA (**Table 3.1-1**). Through the UFA, First Nations are provided with the ability to draft acts to manage Wildlife and Wildlife Habitat on their Settlement Lands. To date, only the TH have exercised this right with the *Tr'ondëk Hwëch'in Fish and Wildlife Act* enacted in 2009 The Act provides authority to TH to manage and administer subsistence harvest of wildlife in the Traditional Territory.

Table 3.1-1 Wildlife and Wildlife Habitat-related Management Boards and Councils Established under the Umbrella Final Agreement

Name of Board or Council	Intended Role
Yukon Fish and Wildlife Enhancement Trust	Supports restoration and enhancement of Yukon wildlife populations and their habitats
Dawson District Renewable Resource Council	Primary local management instrument for Wildlife and Wildlife Habitat in the Traditional Territory of the TH
Selkirk Renewable Resources Council	Primary local management instrument for Wildlife and Wildlife Habitat in the Traditional Territory of the SFN
Mayo District Renewable Resources Council	Primary local management instrument for Wildlife and Wildlife Habitat in the Traditional Territory of the FNNND
Fish and Wildlife Management Board	Primary instrument of Wildlife and Wildlife Habitat management in Yukon

3.1.4 OTHER RELEVANT GUIDELINES AND DOCUMENTS

Fortymile Caribou Herd Management and Harvest Plans — The Fortymile Caribou Herd Management Plan was developed in 1995 through collaboration of the Alaska and Yukon governments, the Tr'ondëk Hwëch'in, Alaska Native organizations, and various environmental, hunting and other interest groups, collectively referred to as the Fortymile Caribou Herd Planning Team. The management plan focused on herd recovery and growth to facilitate the re-occupation of historic range in both Alaska and Yukon, and was developed for a five year period from 1996 to 2001. The management plan recommendations included:

- Maintain habitat quality
- Reduce harvest of Fortymile Caribou during the term of the plan
- Decrease predation on calves by Wolves and possibly by Grizzly Bears, using nonlethal control, and
- Increase public involvement and awareness through outreach.

In support of the management plan recommendations, Yukon licensed harvest was closed and the TH began a voluntary no-harvest program to aid in herd recovery. As per Chapter 16 of the Tr'ondëk Hwëch'in Final Agreement (see **Section 3.1.3**), a Fortymile Caribou herd working group was established and comprised of three representatives each from the YG and the TH. The purpose of the working group was to make recommendations on the use and implementation of habitat protection measures related to the recovery of the Fortymile Caribou Herd. In addition, the working group promotes cross-border cooperation and information sharing between Yukon and Alaska.

The Harvest Management Coalition, a group comprised of representatives of the US advisory committees, the Yukon Fish and Wildlife Management Board (YFWMB), Yukon Department of Environment, and the TH, reconvened in 2005 to draft the 2006-2011 Harvest Plan, and again in 2010/2011, to draft the current 2012-2018 Harvest Plan. The harvest plans have evolved to include the goal of increasing harvest as the herd grows. Currently, the annual allowable harvest (AAH) is set at three percent when the herd numbers fewer than 70,000 Caribou, and increases to four percent when the herd size exceeds 70,000 (Harvest Management Coalition 2012, M. Suitor, Pers. Comm. 2016). Yukon harvest has remained closed and the harvest by TH has remained very low to support further growth of the herd (Tr'ondëk Hwëch'in 2012b; K. Meister, Pers. Comm. 2016; M. Suitor, Pers. Comm. 2016). Yukon Department of Environment has proposed enabling adaptive management of the harvest of Fortymile Caribou in specified GMSs, supported by the YFWMB. However, the Board's support is contingent on the continued commitment to the objectives of the 2012 Harvest Plan, until its renewal in 2018, in which Yukon representatives agreed to put its allocated harvest share back into herd growth.

Management Plan for the Northern Mountain Population of Woodland Caribou (*Rangifer tarandus Caribou*) in Canada (Environment Canada 2012) — The northern mountain population of Woodland Caribou was assessed by COSEWIC in 2002 and listed under SARA as "Special Concern" in 2005. The purpose of this management plan is to summarize the threats facing NMP herds, set out management goals and objectives, and recommend a series of recovery measures for consideration by the responsible authorities for the management of the population's 36 herds. The goal of the plan is to prevent the NMP from becoming threatened or endangered by engaging responsible agencies to carefully manage the NMP and their habitat. The plan is focused on achieving the following goals that are re-evaluated on a five-year basis:

- NMP herds are maintained or recovered, and populations operate within the natural range of variability;
- The ecological integrity of key habitats and ecosystems required by the NMP are maintained; and
- First Nations, local communities, government agencies and other interested parties are meaningfully involved in the stewardship of the NMP and its habitats.

The objectives and recommended recovery measures are based on a set of principles developed by the Northern Mountain Caribou Steering Committee and Technical Working Group. Recommended management objectives for the NMP that are relevant to the Project effects assessment are:

- Objective 1: Determine herd status and trends over time.
- Objective 2: Manage harvest for sustainable use.
- Objective 5: Identify and assess the quality, quantity and distribution of important habitats for the population.
- Objective 6: Manage and conserve important habitats to support Caribou herds.
- Objective 7: Promote conservation of the NMP through environmental and cumulative effects assessments.

Yukon Fish and Wildlife Woodland Caribou Management Decision Guidelines (July 1996) — These interim guidelines (no update or final guidelines are known to exist) were developed by a Caribou management team from YG. The guidelines were intended to provide a framework for consistent departmental input and responses to management plans and programs. Among many guidelines related to harvest, of particular relevance to the Project is guideline no. 16 (habitat), stating:

- Management experience in North America has shown that virtually any type of development activity that increases access for hunters results in a herd decline. Hunter access must be very carefully controlled, particularly where roads bisect Caribou winter range.

The Environmental Code of Practice for Metal Mines (Environment Canada 2009) — The Environmental Code of Practice describes operational activities and associated environmental concerns of metal mines. The document outlines recommendations to mitigate identified environmental concerns, including effects on wildlife, throughout the life of the mine, from design and construction to operations and mine closure.

Yukon Mineral and Coal Exploration Best Management Practices and Regulatory Guide (Yukon Chamber of Mines 2010) — The document is a practical overview to implementing Best Management Practices (BMPs) when planning and conducting exploration projects, from preliminary stages through to the advanced exploration stage. Environmental BMPs including wildlife considerations are identified for a variety of project construction elements including airstrip and road construction.

Best Management Practices for Works Affecting Water in Yukon (Environment Yukon 2011a) — This document provides Yukon-specific BMPs that prescribe practical work-site guidelines to help planners and developers protect water resources. The BMPs provide information that can be used across a broad range of work activities to control erosion, sedimentation, and contamination. Guidelines on vegetation management and revegetation and techniques for preserving natural vegetation and creating wildlife habitat are included.

Flying in Caribou Country: How to Minimize Disturbance from Aircraft (Environment Yukon 2010) — The *Flying in Caribou Country* brochure provides guidelines for flight activities in Yukon where Caribou may exist. Flight guidelines are provided to minimize cumulative disturbances to Caribou from overhead aircraft. Considerations include spatial and temporal constraints, aircraft type, flight pattern, elevation, and Caribou group size and composition. This document is useful for a range of groups including companies conducting mineral exploration activities where frequent helicopter use is expected.

Flying in Sheep Country: How to Minimize Disturbance from Aircraft (Environment Yukon 2006) — Similar to *Flying in Caribou Country*, *Flying in Sheep Country* provides guidelines for flight activities to minimize cumulative disturbances to Sheep. This document provides research results on Sheep behaviour when disturbed and ways that operators can avoid disturbing Sheep when flying near their habitat. Protection measures to consider when flying in Sheep country are similar to Flying in Caribou Country and are intended for a similar audience.

Guidelines for Industrial Activity in Bear Country: For the Mineral Exploration, Place Mining and Oil & Gas Industries (Environment Yukon 2008) —– *Guidelines for Industrial Activity in Bear Country* provides best practices on how to minimize disturbances to bears and bear habitat and to prevent negative bear-human encounters. This document provides information on bear biology and behaviour to guide decisions regarding field activities and camp set-up. Guidelines refer to camp location, design, food and fuel storage, and camp maintenance. Further considerations are provided such as bear awareness training and proper safety equipment as preventative measures. This document is useful for a range of groups such as mineral exploration companies.

Proponent's Guide: Assessing and Mitigating the Risk of Human-Bear Encounters (Environment Yukon 2012) — This guide complements the *Guidelines for Industrial Activity in Bear Country*. It provides guidelines for assessing and mitigating the risks of potential human-bear encounters in an industrial camp setting. It provides information on how to assess the level of risk at a work site or proposed camp site, as well as mitigation measures that can be implemented to minimize encounters. A checklist is included to help assess risk and details regarding mitigation options are provided.

Fish & Wildlife Branch of Environment Yukon Wildlife Key Areas (Environment Yukon 2016a) — The Project area overlaps with several Wildlife Key Areas (WKAs). Most KWAs are identified from population surveys conducted at key times of year, although some information is gathered from individuals knowledgeable about wildlife and their distribution. The areas represent locations that are used by specific wildlife species for critical seasonal life functions (e.g., breeding sites, winter ranges, fall rut areas, mineral licks, and migration corridors). These areas are often used seasonally by relatively large numbers of animals. The WKA data were used to identify areas that may be of specific interest for specific wildlife species.

3.2 BACKGROUND INFORMATION AND STUDIES

3.2.1 TRADITIONAL KNOWLEDGE

As a part of Project data collection, available TK from the TH, the SFN, the FNNND and the WRFN was compiled (i.e., the Project TK database) and reviewed. Available TK was incorporated into the Wildlife Baseline Report (**Appendix 16-A**) and this assessment, where relevant, to supplement other baseline data sources and inform discussion of Project effects.

Much of the available information pertains to the importance of subsistence harvesting for both large and small game species, as well as the past and present importance of trapping for First Nations individuals (InterGroup Consultants Ltd. 2009, Tr'ondëk Hwëch'in 2012a). Wildlife species that were traditionally harvested in the region include Caribou, Moose, Lynx, Wolverine, Fox, Marten, Mink, Beaver, Muskrat, Porcupine, and Snowshoe Hare, among others (Pearse and Weinstein 1988, Mishler and Simeone 2004, InterGroup Consultants Ltd. 2009, Tr'ondëk Hwëch'in 2012a, Bates and DeRoy 2014). The Coffee Creek area in particular was noted as being an important trapping area (Tr'ondëk Hwëch'in 2012a, Dobrowolsky 2014).

The available TK notes that the Project is within the historic winter range of the Fortymile Caribou herd and that Caribou were generally found "in the higher areas" around Coffee Creek (Tr'ondëk Hwëch'in 2012a). Caribou habitat in the area includes habitats with good lichen growth along the ridges around the proposed Mine Site (Bates and DeRoy 2014) and Caribou were generally noted to "frequent mountain ranges, lichen growing areas, and shrubby areas with minimal tree growth" (Tr'ondëk Hwëch'in 2012b). The Coffee Creek area was also reported to be one of the river crossing points historically used by Fortymile Caribou during migration (Tr'ondëk Hwëch'in 2012a, Easton et al. 2013, Dobrowolsky 2014). WRFN members noted that Caribou numbers have declined in the region (Bates and DeRoy 2014).

Additional species known to occur in the region include Moose, Wolves, Bears, Thinhorn Sheep, and a variety of furbearers and small mammals. TH noted the importance of the south facing slopes across the Yukon River from Coffee Creek for bears (Tr'ondëk Hwëch'in 2012a). Higher elevation habitats were noted to be key habitats for both Black and Grizzly Bear (Campbell 2012). The White River area was also reported to provide good habitat for Grizzly Bears, in particular, due to the abundance of High Bush Cranberry in that area (Campbell 2012). Bear Root (*Hedysarum alpinum*) was noted to be an important spring food for bears (Popadynec 2009).

First Nations noted the importance of the natural environment and healthy Wildlife populations (Na-Cho Nyak Dun 2008, Tr'ondëk Hwëch'in 2012b). Several concerns regarding development and effects to Wildlife populations were also highlighted including the effects of helicopter traffic on Wildlife (Campbell 2012, Tr'ondëk Hwëch'in 2012b). Elders also noted that industry, regardless of reclamation efforts, cannot fully mitigate the effects of development to the point that Wildlife will not be affected (Tr'ondëk Hwëch'in 2012b).

3.2.2 Scientific and Other Information

Information on Wildlife used for this assessment was gathered from a number of sources including scientific data and literature, local and traditional knowledge, and input from Territorial and First Nation governments. Specifically, these sources include:

- EDI Environmental Dynamics Inc. — Wildlife surveys conducted as part of the Wildlife Field Program for the Project.
- Access Consulting Group — including data for early and late winter Moose and wildlife surveys.
- Environment Yukon — including early and later winter Moose surveys, collar data for the Fortymile Caribou, Klaza Caribou winter range assessment and inventory studies, Thinhorn Sheep surveys, mineral lick information, guidance for wildlife baseline data requirements and survey methods, harvest and trapping data, and regional population estimates for Grizzly Bear and Black Bear.
- Alaska Department of Fish and Game and Alaska Bureau of Land Management — Caribou collar data.
- Available literature.

Environment Yukon has completed a number of wildlife surveys in the region, mostly focused on Caribou, Moose, and Thinhorn Sheep. Data from these surveys were incorporated and referenced throughout the Wildlife Baseline Report (**Appendix 16-A**). Harvest and trapping data were also provided by Environment Yukon. Environment Yukon provided input and guidance on wildlife and Wildlife Habitat information needs for the Project proposal.

3.2.3 Baseline Studies

A number of field surveys and habitat models were completed for the Project and are summarized in the following reports:

- Wildlife Baseline Report (**Appendix 16-A**)
- Fortymile Caribou Herd Resource Selection Function Model (**Appendix 16-C1**).
- Moose Late Winter Habitat Suitability Report (**Appendix 16-C2**).
- Thinhorn Sheep Habitat Suitability Report (**Appendix 16-C3**).
- Grizzly Bear Habitat Model Report (**Appendix 16-C4**).
- Wolverine Denning Habitat Model Report (**Appendix 16-C5**).
- Wildlife Field Program Report (**Appendix 16-D**).
- Wildfire Burn Probability Analysis (**Appendix 16-E**).

Table 3.2-1 provides a summary of the wildlife field and desktop studies, including the purpose and timing for each survey. Details pertaining to survey methods and spatial boundaries for all studies completed by EDI are provided in the Wildlife Field Program Report (**Appendix 16-D**) or the associated wildlife baseline and habitat modelling reports (**Appendices 16-A** and **16-C**). Details on methods and spatial boundaries for surveys completed by authors other than EDI are summarized in the Wildlife Baseline Report (**Appendix 16-A**).

Table 3.2-1 Summary of Desktop and Field Studies Related to Wildlife and Wildlife Habitat

Study Name	Study Purpose, Duration, and Spatial Boundaries
Early Summer Wildlife Survey	The purpose of the early summer wildlife survey was to provide supplemental baseline information and to document the presence of large mammals and breeding birds within the Project area. June 13–14, 2013 (conducted by Access Consulting)
Early Winter Moose Survey	The purpose of the early winter Moose survey was to document the distribution and composition of Moose within the RSA and to identify key Moose habitats. November 19, 2012 (conducted by Access Consulting) November 13–16, 20 and 22, 2015 (**Appendix 16-D Wildlife Field Program Report**)
Moose Late Winter Habitat Suitability Index (HSI) Model	The purpose of the desktop HSI study was to quantify the distribution and availability of late winter Moose habitat in the RSA. March 2016 (**Appendix 16-C2 Moose Late Winter Habitat Suitability Report**)
Late Winter Ungulate Surveys	The purpose of these late winter ungulate surveys was to document the distribution of Moose and Caribou in the RSA and to identify key late winter habitat areas for those species. February 24, 2011 (conducted by Access Consulting) February 13, 2013(conducted by Access Consulting) February 28–March 5, 2014 March 10–14, 2015 March 7–10, 2016 (**Appendix 16-D Wildlife Field Program Report**)
Aerial Thinhorn Sheep Surveys	The purpose of the sheep surveys was to document Sheep distribution and habitat use along the Yukon River and in the vicinity of the NAR during various times of year. November 22, 2015 (early winter) February 29, 2016 (late winter) May 25, 2016 (lambing) June 13 and 15, 2016 (summer) (**Appendix 16-D Wildlife Field Program Report**)
Ground-based Sheep Investigations	The purpose of the ground-based sheep surveys was to document summer sheep use in the vicinity of Project. May 27–August 28, 2015 June 13–15, 2016 (**Appendix 16-D Wildlife Field Program Report**)

Study Name	Study Purpose, Duration, and Spatial Boundaries
Thinhorn Sheep Habitat Suitability Modeling	The purpose of developing this desktop Thinhorn Sheep habitat suitable model was to assess the amount, distribution and quality of Thinhorn Sheep habitat within the RSA. March 2016 (**Appendix 16-C3 Thinhorn Sheep Habitat Suitability Report**)
Grizzly Bear Den Surveys	The purpose of the Grizzly Bear den surveys was to assess potential denning habitat and determine the timing and use of these areas by Grizzly Bears within the RSA. March 21, 31, April 22, May 6, 2016 (**Appendix 16-D Wildlife Field Program Report**)
Grizzly Bear Habitat Model	The purpose of this desktop study was to quantify potential Grizzly Bear habitat availability and distribution to assess potential Project effects on the regional Grizzly Bear population. This model included an assessment of habitat effectiveness, security areas, linkage zones, and denning habitat suitability within the RSA. April 2016 (**Appendix 16-C4 Grizzly Bear Habitat Model Report**)
Wolverine Denning Habitat Model	The purpose of this desktop study was to quantify potential Wolverine denning habitat availability and distribution within the RSA. March 2016 (**Appendix 16-C5 Wolverine Denning Habitat Model Report**)
Fortymile Caribou Winter Habitat Model	A Resource Selection Function (RSF) model for Fortymile Caribou herd winter habitat use in Yukon is currently being developed in conjunction with Environment Yukon and was not available for analysis during this effects assessment.
Snow Tracking Surveys	The purpose of the snow tracking surveys was to fill data gaps on winter distribution of valued wildlife species which are difficult to survey using other methods. These surveys focused on areas near Project infrastructure and targeted Caribou, Moose, wolves, Wolverine and other furbearers. February 11–15, 2015 February 22–25, 2016 (**Appendix 16-D Wildlife Field Program Report**)
Remote Camera Studies	The purpose of the remote camera studies was to monitor broader wildlife use in areas near Ballarat and Coffee creeks and along the NAR, including the Dawson Goldfield roads. Targeted species included Thinhorn Sheep, Moose, Caribou and Wolf. May 2015 to present. (**Appendix 16-D Wildlife Field Program Report**)
Mineral Lick Investigation	The purpose of the mineral lick investigations was to identify potential and confirmed mineral lick locations in the vicinity of the Project. Ungulates were the targeted species. This information was used to mitigate potential effects on these key habitat areas. August 2–5, 2015 August 26–30, 2015 April 25–26 and June 15, 2016 (**Appendix 16-D Wildlife Field Program Report**)
Acoustic Bat Surveys	The purpose of the acoustic bat surveys was to determine the presence of bat activity in the footprint, in particular for the Little Brown Myotis species which is a *SARA* listed species. August 1–5, 2014 (Camp Location) August 5–11, 2014 (Latte Pitt) (**Appendix 16-D Wildlife Field Program Report)**

Study Name	Study Purpose, Duration, and Spatial Boundaries
Collared Pika Presence/Not Detected Surveys	The purpose of the Collared Pika surveys was to determine their presence within the vicinity of the Project and to fill data gaps on the distribution of this COSWIC Special Concern species. August 25–27, 2014 August 28–30, 2015 (**Appendix 16-D Wildlife Field Program Report**)
Small Mammal Trapping	The purpose of the small mammal trapping was to gather additional baseline information on species presence and to collect tissue samples for targeted species, including mice and voles. Trace metal analysis of tissue samples was conducted for metals which may be encountered following mine development. August 26–31, 2015 **(Appendix 16-D Wildlife Field Program Report)**
Pellet Removal Plots	The purpose of the pellet removal plots study was to monitor changes in Caribou habitat use and distribution in the Project area as a result of mine construction and operation. Summers of 2014 and 2015 **(Appendix 16-D Wildlife Field Program Report)**
Caribou Pellet Collection and Dietary Analysis	The purpose of Caribou pellet collection and dietary analysis study was to determine the composition of forage plants in the winter diets of the Fortymile Caribou herd occupying the Project area. This information will assist in determining winter habitat use and vegetation preference of Caribou in the RSA. Summer of 2014 **(Appendix 16-D Wildlife Field Program Report)**
Java Road Wildlife Trail Investigations	The purpose of the Java Road wildlife trail investigations was to document wildlife use surrounding the Java Road (mine access road). The results of this study identified potential wildlife crossing areas. Summer of 2014 **(Appendix 16-D Wildlife Field Program Report)**
Incidental Wildlife Log	The purpose of the wildlife log is to document wildlife observations in the Project area and interactions with Project personnel and facilities. Ongoing **(Appendix 16-D Wildlife Field Program Report)**

3.3 EXISTING CONDITIONS

Existing conditions for each Wildlife and Wildlife Habitat subcomponent are described in detail in the Wildlife Baseline Report (**Appendix 16-A**). Existing conditions are pre-Project conditions prior to development and are summarized for each subcomponent based on TK, scientific, and other information, and baseline studies conducted for the Project. Existing conditions inherently include effects from other projects and activities, such as mineral exploration and placer mining. As per YESAB (2007) draft guidance, existing conditions are described in sufficient detail to enable potential Project interactions with Wildlife and Wildlife Habitat to be identified, understood, and assessed.

3.3.1 FORTYMILE CARIBOU

The Fortymile Caribou herd (FMCH) is a migratory ecotype of Barren-ground Caribou. Historically, the FMCH was one of the largest Caribou herds in North America. In the 1920s, the herd was estimated to have reached a population peak of between 260,000 and 569,000 animals (Murie 1935; Boertje et al. 2012). At the herd's peak, they ranged across large areas of Alaska and Yukon, including the entire Project RSA. The herd experienced a population decline during the 1930s (McDonald and Cooley 2004) followed by further declines until it reached its smallest recorded size in 1973 of between 5,740 and 8,610 Caribou (Valkenburg et al. 1994). As the population decreased, the herd disappeared from large portions (>75%) of its historic range (Gronquist et al. 2006) including nearly all of its range in Yukon. The herd began increasing in size again through the mid-1970s and 1980s, until population growth stagnated at approximately 22,000 Caribou in the early 1990s (Gronquist et al. 2006). During this period, very few Caribou crossed into Yukon, although starting in 1985, small numbers were infrequently found in Yukon (McDonald and Cooley 2004). The Alaska Department of Fish and Game, YG, and TH governments responded with management actions including harvest management, predator management (Alaska only) and public outreach. In response to recovery efforts, the FMCH increased in size to 40,204 by 2001, and in the fall of 2002, the herd began its first major movement into Yukon since the 1960s with tens of thousands of Caribou returning to Yukon and extending the herd's winter range into areas west of Dawson, in the vicinity of the Yukon, Forty Mile, Sixty Mile, and Ladue Rivers (Barker and Hegel 2012). By 2010, the herd was estimated at 51,675 Caribou (Boertje et al. 2012); however, the herd range in Yukon was still largely restricted to habitats along the north shore of the Yukon River downstream of Dawson and along the Top of the World Highway, Sixty Mile River, and Ladue River. In the fall of 2013, the FMCH made another eruptive movement east into Yukon, reoccupying large areas of their historic range, including parts of the Project RSA. The Fortymile Caribou Herd is currently estimated at approximately 52,000 animals based on the 2010 population estimate.

The FMCH displays the long distance movements between relatively distinct seasonal ranges characteristic of migratory Barren-ground Caribou. The herd calves and summers in the higher elevation habitat of the Yukon-Tanana Upland (Tanana Hills) in east-central Alaska. This portion of the herd's range has remained its core range during the population lows and Caribou occupy this area during all seasons (Boertje et al. 2012).

Historically, the Yukon portion of the FMCH range was used primarily during the fall and winter months, although there are reports of summer use, along with a single observation of calving in Yukon in 1959 (McDonald and Cooley 2004). Since reoccupying portions of their Yukon range, Fortymile Caribou are present seasonally. Analysis of satellite collar data and Project survey data found that Fortymile Caribou are generally using habitats in Yukon and the Project RSA during the winter months, between October and April. A small amount of summer use was also detected in Yukon; however, these Caribou were generally located close to the Yukon-Alaska border and no summer use of the RSA was detected (**Figures 2-5** and **2-6** in the Wildlife Baseline Report, **Appendix 16-A**).

Between 2013 and 2016, the main movement into the Yukon (FC-RAA) and the Project RSA was observed in October, with smaller movements observed in November as Caribou spread out on the winter range. Between December and March, Caribou within the RSA are relatively sedentary on the winter range, although baseline studies found that some Caribou began to initiate movements back to Alaska in mid- to late February. By the end of April, Caribou have typically left the RSA. Boertje et al. (2012) defined six seasons for the FMCH including Autumn Migration (16 August – 30 September), Rut/Early Winter (1 October – 30 November), Winter (1 December – 31 March), and Pre-calving (1 April – 10 May). These seasons are generally consistent with the observed use of the RSA since 2013, although the fall movement period appears to extend into the Rut/Early Winter, and the pre-calving movement appears to begin in the later months of the winter season.

Winter range is generally the largest of the seasonal ranges for Barren-ground Caribou, and often overlaps with the winter ranges of other Caribou herds. During winter, Caribou travel extensively to access winter forage. Distribution and movement of the FMCH in the winter are unpredictable. Since 2013, the winter range of the FMCH has included large portions of the Project RSA; however, winter distribution has varied between years. During the winters of 2013/2014 and 2015/2016 satellite collared Caribou locations showed that a considerable portion of the herd was in Yukon, including parts of the RSA. However during the winter of 2014/2015, the herd only used the very western edge of Yukon and no collared animals used the RSA (**Figures 2-5** and **2-7** in the Wildlife Baseline Report, **Appendix 16-A**). This is consistent with the results of Project surveys. The late winter survey in March 2014 recorded 1,146 Fortymile Caribou occupying areas within the southern portion of the RSA (south of Thistle Mountain and the Barker-Ballarat summit; the 2014 survey did not yet include the northern portion of the RSA). During the winter of 2014/2015, very few Caribou were observed within the late winter survey extent (note that the survey extent did not encompass the entire RSA, refer to the Wildlife Field Program Report, **Appendix 16-D**) with only 21 Caribou documented during the 2015 late winter survey. Caribou were again observed in large numbers in the 2015/2016 winter surveys — more than 5,000 Caribou were observed incidentally during the early winter Moose surveys in the RSA in November 2015 (Wildlife Baseline Report, **Appendix 16-A**). During the March 2016 late winter survey, only 290 Caribou were observed within the survey extent; however, surveyors noted an abundance of tracks (both old and new) in various locations through the area. While large numbers of Caribou were present in the Project RSA during the winters of 2013/2014 and 2015/2016, based on satellite collar data, in both years the RSA overlapped only a portion of the Yukon winter range (FC-RAA) used that year and use of the RSA by collared Caribou represented less than 25% of the use in the FC-RAA.

The average residency time in the Project footprint, the RSA, and Yukon (FC-RAA) was calculated using all three years of collar data and the maximum and minimum amount of time any one individual Caribou spent in each of the respective areas from the three years of data were used as the maximum and minimum residency times. The average residency time in the Project footprint for all collared Caribou over the three years of data collection was only 0.01 days (range 0–0.18 days) whereas the average residency time in the

RSA was 15.97 days (range 0–162.26 days) and the average residency time in the entire FC-RAA was 74.77 days (range 1.00–183.00 days). Based on this information, collared Fortymile Caribou have spent a relatively small amount of time during the winter season in the Project footprint area relative to the time spent in the remainder of the RSA and FC-RAA, suggesting that while the area could be used, to date, use has been relatively brief.

Winter habitat selection by Fortymile Caribou was assessed using resource selection (RSF) function analysis (Muhly 2017; Wildlife Baseline Report, **Appendix 16-A**). Data on Caribou use was obtained from 60 Caribou affixed with GPS telemetry collars that were monitored between 2012 and 2016 as part of a joint study by the Alaska Department of Fish and Game and Bureau of Land Management in the United States of America, and by Environment Yukon in Canada. Habitat variables used in the analysis consisted of spatial data available in a GIS and included EOSD Land Cover Classes, normalized difference vegetation index (NDVI) values, slope, aspect, distance to water, and road density.

Results of the RSF analysis indicated that:

- Caribou selected home ranges farther from large rivers.
- Caribou selected areas that were burned 41 to 60 years ago, but avoided areas burned 11 to 40 years and 61 to 70 years ago, or that were not burned, relative to recently burned areas (less than 10 years ago).
- Caribou selected all vegetation cover types relative to barren cover, except for dense conifer forest. Bryoids were the strongest selected vegetation cover type, followed by sparse mixedwood forest, water, shrubland, and dense broadleaf forest.
- Caribou selected east and west aspects relative to north aspects, and avoided flat aspects.
- Caribou avoided areas with high-use road densities greater than 0.05 km/km^2 and areas with low-use road densities greater than 0.10 km/km^2.
- Caribou selected areas with intermediate NDVI values.
- Caribou selected slopes between 20 to 30 degrees.

Based on the model results, habitat selection probabilities were predicted across the study area (Wildlife Baseline Report, **Appendix 16-A**). Model predictions indicate that 25% of the habitat within the FC-RAA is rated as high or moderate (use by Caribou was greater than the frequency of random points).

Winter habitat selection by Caribou herds in Yukon has previously been statistically modeled using a combination of fire history, vegetation cover, terrain, and human disturbance variables (Florkiewicz et al. 2004, 2007; Collins et al. 2011) including for the Fortymile Caribou Herd using aerial survey data from 2008–2010 (Barker and Hegel 2012). Although the significance of, and coefficient values for, covariates vary among studies, results tend to consistently support two primary mechanisms driving selection — avoidance of predation risk and selection of foraging habitat. In other studies, selection of mid-upper elevation habitats is likely a result of avoidance of predation and greater snow depth in valley bottoms, and poor forage availability and climatic conditions at high elevations (James et al. 2004; Gustine et al. 2006; Barker and Hegel 2012).

Lichens, the primary winter forage for Caribou, appear to be a primary driver of Fortymile Caribou habitat selection (Barker and Hegel 2012). During winter, Caribou consume approximately 1.3–4.9 kg of lichen per day (Holleman et al. 1979), accounting for more than half of forage intake. The abundance of lichens is often influenced by forest community type (e.g., dry, mature coniferous forests), soil characteristics, topography, grazing, and the time since disturbance (i.e., from land clearing or forest fire; Joly et al. 2010). In Yukon, lichen abundance is largely determined by wildfire history. Consequently, lichen availability and fire history are often the main variables determining winter habitat selection and distribution.

During Project surveys, Fortymile Caribou were observed in a range of habitat types ranging from low elevation forest to alpine and subalpine ridges; however, the majority of Caribou observed during the Project surveys were using subalpine areas within the survey extent, with concentrations in the high elevation areas to the north of the Yukon River from Thistle Mountain east to Selwyn Dome (Wildlife Baseline Report, **Appendix 16-A**).

At present, licensed Caribou harvest is closed year round in all GMSs that overlap the Project footprint and TH has a voluntary no-harvest program in place for the FMCH. Consequently, Yukon harvest is currently limited to a very small First Nations' harvest (Tr'ondëk Hwëch'in 2012b; M. Suitor, Pers. Comm. 2014-2016; K. Meister, Pers. Comm. 2016; N. Ayoub, Pers. Comm. 2016). With the expanding herd range and increasing herd size, Yukon and TH governments are considering re-opening Yukon harvest for Fortymile Caribou (M. Suitor, Pers. Comm. 2014-2016; K. Meister, Pers. Comm. 2016). By agreement of the Fortymile Caribou Harvest Coalition parties, Yukon hunters are allocated 35% of the annual allowable harvest (Harvest Management Coalition 2012), which corresponds to a harvest of more than 500 Caribou per year in Yukon at the current herd size.

3.3.2 KLAZA CARIBOU

The Klaza Caribou Herd (KCH) also seasonally overlaps the southern portions of the Project area. The KCH are part of the NMP of Woodland Caribou that is listed as Special Concern on Schedule 1 of *SARA*. The most recent (2012) population estimate for the KCH was 1,179 Caribou (Hegel 2013). The herd was first studied and identified as a discrete group of Caribou during a 1987–1990 inventory (Farnell et al. 1991). Since the first herd inventory, the population has continued to be studied and monitored. Since 1985, there have been 15 years of monitoring collared Caribou and 17 years of aerial surveys, making it one of the better studied Woodland Caribou herds in Yukon.

Woodland Caribou are a sedentary ecotype of caribou that do not exhibit the long distance movements characteristic of Barrenground Caribou such as the FMCH, although individual animals many move extensively within the annual range. The KCH range, centred in the Dawson Mountain Range, covers 1,081,922 ha. The KCH uses alpine and subalpine habitats during most of the year. In the spring female Caribou disperse to calve in higher elevation habitat as a predatory avoidance strategy. The Caribou remain at higher elevations for the summer, fall, and into the winter. As winter progresses, Caribou descend to lower elevations at or below treeline where snow depth and hardness are more favourable for accessing winter forage. In winter, they inhabit lichen-rich mature and old coniferous forests where snow is relatively shallow.

The Mine Site is located on the periphery of the KCH annual range and is the only part of the Project footprint that overlaps the KCH range (i.e., the NAR does not overlap the KCH range), and only a portion of the Mine Site is physically within the annual range boundary (see **Figure 2-9** in the Wildlife Baseline Report, **Appendix 16-A**). Critical habitat for the KCH is considered to be late winter range where the Caribou spend the winter months feeding on lichen when other forage sources are limited. The KCH late winter range encompasses approximately 431,300 ha and is located, at the closest, 34 km to the southeast of the Project footprint. As such, the Project is only expected to interact with the KCH during non-winter months, within the larger annual range area.

Based on Project wildlife observation logs maintained by on-site personnel and incidental observations during baseline studies, approximately 74 suspected Klaza Caribou have been documented within the RSA since 2010. Due to the timing of these observations during summer months when Klaza Caribou are present, the animals are assumed to belong to the KCH, because Fortymile Caribou are generally only present during winter months. Suspected Klaza Caribou have been observed between May and September, typically as one or two individuals, with a few sightings of larger groups (i.e., 12 to 17 individuals). Sightings include adult male and females, and calves. Based on observations to date, the Project is expected to interact with the Klaza caribou herd during the spring, summer, and/or fall months but Caribou are not expected to use the RSA in any considerable numbers.

Caribou are an important subsistence species for some First Nations and other Yukon residents. Harvest records indicate that pressure on the KCH has been relatively low. According to Yukon 2015/2016 regulations (Environment Yukon 2015a) Caribou harvest in GMSs that may contain Klaza Caribou within the RSA are closed to Caribou hunting. Licensed hunters require a lottery draw permit to harvest Klaza Caribou in GMSs 511, 513 and 522 to 526, which are located outside of the RSA to the southwest (**Figure 1-4** in the Wildlife Baseline Report, **Appendix 16-A**). The lottery draw allows for a harvest of 12 bull Caribou per year. It is reported that hunter success is 6.7 bulls per year (Hegel 2013). The 2015 KCH harvest was less than 1% of the 2012 population estimate. Current licenced harvest of the KCH is concentrated away from the Project RSA in GMSs 523 and 526, with the majority of resident harvest in

GMS 526, likely because of access to Caribou along the Mount Nansen Road. Non-resident harvest pressure is mostly within GMS 523, presumably from guided hunters accessing more remote areas using aircraft.

3.3.3 MOOSE

The total Yukon Moose population is estimated to be approximately 70,000 (Environment Yukon 2016b). The average density of Moose in Yukon typically ranges from 150 to 249 Moose/1,000 km² (Environment Yukon1996). Overall, Moose densities in the RSA are close to the Yukon average, with some of the northern regions possibly higher than average. In the southern sections of the RSA, Moose densities are estimated at 170 per 1,000 km² based on a 2012 survey of the region (O'Donoghue et al. 2013). The 2012 survey indicated that calf survival was relatively low (21 calves per 100 cows), while yearling and bull ratios were healthy. The northern portions of the RSA were most recently surveyed in 2015 and based on the preliminary survey results, Moose densities in this area are estimated at 277 per 1,000 km² (Suitor, pers. comm. 2016). During the 2015 survey of the Dawson Goldfields, the Project team collaborated with Environment Yukon to extend the survey along the NAR, resulting in a population estimate within 10 km of the NAR from the junction with the Klondike Highway to the Yukon River. An estimated 814 moose (90% Confidence Interval of 723–917) are expected to occur within this area at a density of 247 moose/1,000 km² (Suitor, pers. comm. 2016).

Moose are known to be widely distributed across the RSA. In the early winter during the post-rut season, Moose can be widely distributed in a variety of habitat types, but tend to congregate in the extensive shrub communities of the subalpine. Post-rut congregations are known to occur in several areas within the RSA in willow-dominated subalpine habitats. When snow loads are low, Moose may stay in these high elevation early winter habitats year round, but with deeper snow, Moose are forced down into lower elevation areas during the late winter. Within the RSA, however, late winter ungulate surveys have indicated that snow depths may not be as restrictive as in other parts of Yukon and that during the late-winter season Moose may be distributed over a wider range of elevations as compared to other areas. Late winter surveys found Moose in a variety of habitat types, but particularly in willow-rich areas such as burns, forest openings, disturbed areas, subalpine shrub, and along creeks and rivers (O'Donoghue et al. 2013a, Wildlife Baseline Report, **Appendix 16-A**; Wildlife Field Program Report, **Appendix 16-D**). Analysis of late winter ungulate survey results indicate that several parts of the survey extent show higher concentrations of Moose during the late winter including the southwestern sections of the RSA along the White River, the upper sections of the Henderson Creek and Black Hills Creek drainages, and just north of the Indian River (Wildlife Baseline Report, **Appendix 16-A**).

Late winter habitat suitability modeling indicates that 43% of the habitat within the RSA is rated as High or Moderate quality late winter Moose habitat (26% of the RSA rated as High, 17% rated as Moderate; illustrated in **Figure 4** of the Moose Late Winter Habitat Suitability Report, **Appendix 16-C2**). The largest areas of contiguous High-rated late winter habitat occur north of the Stewart River, with smaller patches located north and south of the Yukon River.

Moose are the primary harvest species within the RSA and are a highly valued species for both First Nations people and licensed hunters. All GMSs in the RSA are open to licenced hunters for bull Moose with an annual bag limit of one. Much of the RSA, particularly the Dawson Goldfields region, is very accessible to hunters due to an abundance of roads and trails. These areas experience relatively high levels of harvest pressure.

3.3.4 THINHORN SHEEP

Approximately 22,000 Thinhorn Sheep occur in the mountainous regions of Yukon (Environment Yukon 1996a). Densities range from more than 30 Sheep/100 km² in portions of the St. Elias Mountains to less than 2 Sheep/100 km² in the Dawson Range in central Yukon (Barichello et al. 1989). Thinhorn Sheep have specific habitat requirements, primarily the need for steep, rugged rocklands that are used as 'escape terrain' to avoid predators (Geist 1971). They also require seasonal foraging areas and secluded lambing areas in association with escape terrain. Foraging areas are predominantly grass and forb dominated habitats (Seip and Bunnell 1985), such as alpine tundra, south aspect slopes, and, occasionally, low elevation meadows. Winter range is typically used from early September to May, and consists of foraging habitat associated with escape terrain, with characteristics that reduce snow accumulation. These characteristics can include a combination of lower elevation, south aspect, and wind prone slopes. In May, Sheep typically begin moving away from their winter range, following the progression of new plant growth to higher elevations. Pregnant ewes normally seek steep, secluded areas away from other Sheep in May and June to birth and rear their lambs before regrouping with other Sheep in the summer. Summer range tends to be the most widespread of seasonal Sheep habitats and includes a variety of foraging types in association with escape terrain and is often located at the highest elevations, but can include a range of elevations and can overlap with winter range. Mineral licks can also be important habitat features for many Sheep populations. Mineral licks can be used at any time during the spring and summer, but use is typically highest in June and July. Sheep may travel several kilometres away from escape terrain and through forested areas to access mineral licks (Simmons 1982).

Thinhorn Sheep occur in low densities at sporadic, isolated locations within and adjacent to the RSA. There are records of Thinhorn Sheep from two general areas: Mount Maclennan, located approximately 14 km south of the proposed mine site, and the steep south-facing bluffs along the Yukon River. Mount Maclennan is known to have previously supported a population of 12–15 Sheep; however, no Sheep have been recorded in the area since 1990 and it is believed that the area 'may have been hunted out' (Environment Yukon 2016c). The other area known to support Sheep is the steep, non-forested, south aspect hillslopes with rockland bluff complexes, along the north side of the Yukon River. Baseline studies delineated three occurrence areas for Thinhorn Sheep along the Yukon River bluffs, one in the RSA and two additional occurrence areas just outside the RSA. All three of these occurrence areas overlap WKAs delineated by Environment Yukon. The occurrence area closest to the Project is in the vicinity of Ballarat Creek. That area was first surveyed by Environment Yukon biologists in July 2010; however, there are anecdotal reports dating back to the Yukon gold rush of Sheep using this area (Russell pers. comm. 2015). Environment Yukon surveys in 2010 and 2011 documented a maximum of eight Sheep in the Ballarat Creek occurrence area (Russell et al. 2011). More recently, several Project surveys have also located Sheep in this area; however, no more than four sheep have been observed here during Project surveys (**Table 2-10**, Wildlife Baseline Report, **Appendix 16-A**). Outside of the Project RSA, Thinhorn Sheep can be found along the steep slopes near the confluence of the White and Yukon rivers (referred to as White River occurrence area) approximately 45 km northwest of the Ballarat occurrence area, and on the north slope of the Yukon River between the Pelly River confluence and Minto Landing (referred to as the Minto occurrence area) approximately 85 km west of Ballarat. At the White River occurrence area, Environment Yukon surveys documented 13 Sheep in July 2010 and 17 in February 2011 (Russell et al. 2011). The White River occurrence area was also surveyed during the 2016 late winter Sheep survey for the Project; five Thinhorn Sheep were observed here during the survey; however, weather conditions prevented a full count of the Sheep present (Wildlife Field Program Report, **Appendix 16-D**). The Minto occurrence area has been monitored annually from 2000–2014 (O'Donoghue and Winter-Sinnott 2014). Over that period, annual counts have ranged between 31 and 129 Sheep, with a generally increasing trend from approximately 45 animals in the early 2000s to approximately 100 animals over the last three years (O'Donoghue and Winter-Sinnott 2014). The Project late winter sheep survey in 2016 recorded 102 Thinhorn Sheep in this area (Wildlife Field Program Report, **Appendix 16-D**).

The three occurrence areas of Sheep along the Yukon River valley slopes are a unique setting for Thinhorn Sheep in Yukon, as most Yukon occurrences are associated with alpine or subalpine areas (Environment Yukon 1996a; Hayes 2015). There are several factors associated with the Yukon River setting that may affect the habitat use, movement patterns and population dynamics of the Sheep using those areas including small size of the habitat areas (a few kilometres long and few hundred metres wide), low numbers of Sheep in each area, distance between occurrence areas (45–85 km), location below treeline, and year-round use of the same areas (Russell et al. 2011; O'Donoghue and Winter-Sinnott 2014).

Based on the existing survey information, it is believed that there is likely occasional movement of animals among the three occurrence areas. The maximum of eight Sheep observed at the Ballarat Creek occurrence area is well below the threshold necessary for a self-sustaining isolated population. Minimum viable population studies completed on 122 Bighorn Sheep (*Ovis canadensis*) populations in western North America determined that all isolated Sheep populations with fewer than 50 individuals went extinct within 50 years (Berger 1990). The distances between the three areas (45 km from White River confluence to Ballarat and 85 km from Ballarat to Minto) are farther than Sheep normally move on an annual basis; however, individual animals or small herds will occasionally make dispersal movements over those distances (Geist 1971). In other parts of North America, several Sheep populations have been described as having metapopulation structures (e.g. Bleich et al. 1996; Epps et al. 2005; Akçakaya et al. 2007), that are characterized by isolated subpopulations, in discreet occurrence areas separated by unsuitable habitat, that exhibit a pattern of extirpation and recolonization of individual areas over a period of many years. If a metapopulation dynamic is occurring along the Yukon River, the Ballarat occurrence area might be considered a 'satellite' subpopulation (Hanski and Gyllenberg 1993) that is likely to experience more frequent extirpations, and longer vacancies, due to its small geographic size and small subpopulation number. The Minto occurrence area might be a 'core' subpopulation that is rarely extirpated and which is a regular source of emigrating animals to recolonize or supplement satellite areas like Ballarat. Without immigration to supplement or recolonize the Ballarat occurrence area, long term persistence of Sheep there is uncertain. Empirical observations of small Sheep populations have observed both extinctions and persistence over periods of several decades, and the factors that affected those outcomes varied widely among populations (Krausman 1997).

Assuming Thinhorn Sheep travel among the three known occurrence areas, the most likely movement corridor is along a series of steep hillslopes and ridges that occur on the north side of the Yukon River. Those hillslopes offer good foraging habitat in many locations, and limited escape terrain for travel and stopover habitat (Wildlife Baseline Report, **Appendix 16-A**; Thinhorn Sheep Habitat Suitability Report, **Appendix 16-C3**). During four aerial surveys conducted between 2010 and 2015 along the Yukon River between the Minto occurrence area and the White River confluence area, no Sheep were detected outside of the three known occurrence areas (Wildlife Field Program Report, **Appendix 16-D**). In addition to the relatively long distances between occurrence areas, Sheep would have to cross either the Pelly River or the Yukon River to travel between occurrence areas.

Thinhorn Sheep are known to be a traditional seasonal food source for all four First Nation groups with asserted or established traditional territories that overlap the Project (Bates and DeRoy 2014; InterGroup Consultants Ltd. 2009; Dawson Indian Band 1988; McClellan 1987; Mishler and Simeone 2004; Pearse and Weinstein 1988); however, the areas where Sheep hunting traditionally occurs are outside the TS-RAA and there is no documented TK of Sheep being selected for harvest where they occur along the Yukon River. There is little information available on current unlicensed or subsistence harvest; however, local trap line concession holders have indicated that they are not aware of any subsistence harvest of Sheep in the Ballarat area (Interview 14, Pers. Comm. 2016). Hunting in the Minto area is described as "light" by O'Donoghue and Winter-Sinnott (2014). All three occurrence areas along the Yukon River are located within Game Management Zone 3 which is closed to licensed Sheep hunting.

3.3.5 GRIZZLY BEAR

Grizzly Bear are a large omnivore found across western and northern Canada (COSEWIC 2012). Grizzly Bears have a large distribution throughout Yukon, ranging from the B.C./Yukon border to the Arctic coast. Grizzly Bears have large home ranges that are determined by the distribution of food and available cover, and possibly competition avoidance (Rigg 2005). The Yukon population is estimated to be between 6,000 and 7,000 individuals, making up about 25% of the total Grizzly Bear population in Canada (COSEWIC 2012). There is limited available information on Grizzly Bear abundance and distribution within the W-RAA, but Grizzly Bear density in the area is considered to be low (R.Maraj. Pers. Comm.). The working density estimates for the Klondike Plateau ecoregion is 11 bears/1,000 km² and the Yukon Plateau-Central is 15 bears/1,000 km² (Environment Yukon 2011b).

Grizzly Bear is listed as a species of Special Concern (COSEWIC 2012). COSEWIC has identified the largest threats to Canadian Grizzly Bear population as 1) human caused mortality (including illegal and legal hunting, defense of life or property, and accidental killings) and 2) habitat loss and fragmentation (COSEWIC 2012). In Yukon, Grizzly Bear is listed as Sensitive by the Canadian Endangered Species Conservation Council (CESCC 2011).

Six Grizzly Bears were harvested from GMSs within the W-RAA from 2006 to 2015 including GMSs 307, 308, 313, 314 and 509. Grizzly Bears were not harvested in the other GMSs found in the W-RAA during that time period (GMSs 310, 311, 312, 315, 502, and 503). There is a bag limit of one Grizzly Bear every three years in open GMSs (Environment Yukon 2015a). One other mortality was also recorded within the W-RAA in GMS 311 (Wildlife Baseline Report, **Appendix 16-A**).

Grizzly Bear observations were recorded throughout the RSA on wildlife cameras, during baseline studies in the area and by Project personnel. Grizzly Bears were documented on 13 separate occasions on remote cameras, and incidentally by EDI biologists during baseline surveys on 5 occasions. Grizzly Bears were also reported on the Camp Wildlife Log on 15 occasions between 2010 and 2016 (Wildlife Baseline Report, **Appendix 16-A**; Wildlife Field Program Report, **Appendix 16-D**). Grizzly Bear observations were made throughout the RSA including observations in the Dominion Creek valley, Eureka Ridge, Maisy May Creek valley, Barker Creek valley, Ballarat Creek valley, and the Coffee Property. The observations and harvest records support that Grizzly Bears occur at low densities which is consistent with current estimates by Environment Yukon (2011b) for the region.

Baseline Grizzly Bear habitat modeling included habitat effectiveness, security areas, linkage zones, and denning habitat suitability. Modelled habitat effectiveness as a proportion of potential habitat if no disturbance existed in the W-RAA was 92.3% for the green-up period (peak greenness in July) and 91.8% for the green-down period (senescence in September). Habitat effectiveness was lowest in areas with high human development near Dawson and in the Dawson goldfields area (Grizzly Bear Habitat Model Report,

Appendix 16-C4). Security areas modeling revealed that within the RAA, 94.7% of the area is considered secure and 5.3% is considered not secure. Non-secure habitat typically occurs in areas with relatively high levels of human activity as a result of their proximity to Dawson and placer mine operations (Grizzly Bear Habitat Model Report, **Appendix 16-C4**). Linkage zones modeling identified 92.5% of the RAA to be in the minimal danger category with 3.7% as low danger. Moderate and high danger categories occurred over 3.8% and <0.1% of the W-RAA, respectively. The highest danger levels typically occurred in the northern part of the W-RAA between the Indian River and Dawson (Grizzly Bear Habitat Model Report, **Appendix 16-C4**). Denning habitat suitability modeling identified 22.8% of the W-RAA as not available for denning habitat (i.e. nil), 1.6% was low suitability, 27.1% was low-moderate suitability, 38.9% was moderate suitability, 9.1% was moderate-high suitability, and 0.5% was high suitability. In general, areas with the highest percent availability of moderate-high and high denning suitability were located in the southern portion of the W-RAA, south of the Yukon River where high elevation mountainous areas occur (Grizzly Bear Habitat Model Report, **Appendix 16-C4**).

Den surveys were completed in the spring of 2016 (March 21–May 6) as part of baseline data collection, in areas considered to be most suitable for Grizzly Bear denning (moderate to high-rated habitat) based on habitat suitability modeling (Grizzly Bear Habitat Model Report, **Appendix 16-C4**). No Grizzly Bears or their sign were observed during denning surveys although suspected Black Bear denning sites were located on south aspect slopes (Wildlife Field Program Report, **Appendix 16-D**). Outside of the denning surveys, two suspected Grizzly Bear dens were observed on a steep south-facing slope above the Yukon River during other Project surveys.

3.3.6 WOLVERINE

Wolverine has a circumpolar distribution and is the largest mustelid in North America. Densities of Wolverine are generally low compared to other terrestrial mammal species. The low density is thought to be linked to food availability. The estimated population of Wolverine in Canada is unknown but assumed to be greater than 10,000 individuals (COSEWIC 2014). In Yukon, the Wolverine population is estimated to include 3,500–4,000 animals (COSEWIC 2014). Wolverine densities in Yukon are some of the highest reported in North America, estimated at approximately ten Wolverine per 1,000 km² (Banci and Harestad 1990, Golden et al*.* 2007). The exact density of Wolverine in the W-RAA is unknown.

Wolverine are designated a species of Special Concern by COSEWIC (2014), with the primary reasons for the designation being human caused effects on the southern Canadian portion of the species range, risks associated with climate changes, and a lack of available information (COSEWIC 2014).

Wolverine have adapted to exist in diverse habitats and landscapes throughout their circumpolar range. Wolverine are generally associated with undisturbed habitats including the boreal forest, alpine, and high arctic tundra (Copeland *et al.* 2010), and are able to exist where there is suitable prey; consequently, they are not selective for foraging habitat as they simply persist where sufficient food is available. Wolverine in the W-RAA are unlikely to be limited by food availability, as they will have increasing access to food as the FMCH starts to reoccupy Yukon (Wildlife Baseline Report, **Appendix 16-A**). However, Wolverine are sensitive to human disturbance, including roads, infrastructure, and backcountry recreation (Hornhocker and Hash 1981, May et al. 2006, Krebs et al. 2007).

Wolverine are known to occur in the W-RAA. Wolverine or their sign were observed during wildlife baseline surveys in 2015 and 2016 (Wildlife Field Program Report, **Appendix 16-D**). In 2015, fresh tracks of one Wolverine were recorded travelling the length of the airstrip. Furthermore, in 2016, 14 occurrences of fresh Wolverine tracks and eight old tracks were encountered within the Coffee Property and along the NAR in the following areas: Java Road, Thistle Mountain, Barker Creek, Maisy May, Eureka Ridge and Sulphur Creek. Along the NAR, Wolverine tracks were observed more commonly at higher elevations (range 470–1,309 m; average 858 m). Wolverines were captured on wildlife cameras located on Eureka Ridge and Sulphur Creek Road, along the NAR. A Wolverine was also observed within the Coffee Property approximately 7.5 km south of the existing road between the Yukon River and the deposit (i.e., the Java Road). Wolverine are also harvested in the W-RAA; within trapping concessions that intersect the W-RAA, between 2004 and 2013 the average wolverine harvest was 10 wolverine per year (Wildlife Baseline Report, **Appendix 16-A**).

Wolverine dens are considered critical habitat but are often difficult to find (Copeland et al. 2010). The denning period, from late winter to early spring, is considered to be the most sensitive time of the year for Wolverine (Heinmeyer and Copeland 1999, Heinemeyer et al. 2001). Wolverine dens have been reported almost exclusively above treeline within deep snowdrifts. Dens within forested habitats are uncommon (Magoun and Copeland 1998). Dens require deep snow and are reported in large snowdrifts greater than 1 m deep (Magoun and Copeland 1998). Snow cover through the denning season was suggested as a primary factor driving den site selection and a potential limitation to the distribution of Wolverine throughout their global range. Snow cover has also been demonstrated to predict Wolverine den locations (Copeland et al. 2010).

A Wolverine denning habitat model using remotely sensed snow cover estimates from 2006–2015 found that the area likely contains limited high quality denning habitat (Wolverine Denning Habitat Model Report, **Appendix 16-C5**). The W-RAA contains few areas of regular late snow through the denning season. Based on the model, 0.2% and 9.1% of the W-RAA was classified as high and moderate quality denning habitat, respectively. Furthermore, 72.1% was modelled as low suitability and 18.6% as very low suitability within the W-RAA. The denning habitat model suggests that there is little suitable denning habitat within the W-RAA; consequently, the Wolverine population in the region may be limited by the availability of denning habitat. Areas where Wolverine are most likely to den within the W-RAA are concentrated in the higher elevation terrain with late snow cover, primarily along the high ridges south and west of the Yukon River.

3.3.7 LITTLE BROWN MYOTIS

Little Brown Myotis is common across much of Canada and it is believed that the total population was likely greater than one million and relatively stable prior to the discovery of White-nose Syndrome in 2006 (COSEWIC 2013). The Little Brown Myotis is listed as Endangered under SARA. Several recent studies of bat colonies infected with White-nose Syndrome in eastern Canada and the United States show a decline of greater than 90% of the population within three years of infection (Mainguy and Derosiers 2011; Turner et al. 2011; COSEWIC 2013). White-nose Syndrome remains the primary concern for conservation of this species although White-nose Syndrome is not believed to have expanded into Yukon bat populations yet (COSEWIC 2013). Ongoing studies of Little Brown Myotis in Yukon aim to increase knowledge of this species and establish a long-term data set to assess population trends territorially (Jung and Kukka 2014).

Within Yukon, historical records confirm the presence of the Little Brown Myotis from Dawson south to the British Columbia border (Slough and Jung 2008). Females typically begin to occupy maternity colony roosts in Yukon during the last two weeks of April, with pups typically born from late June through mid-July. Maternity colonies began to disband in early August with only a few bats, mainly juveniles, remaining by late-August or September (Slough and Jung 2008) or even early October (Environment Yukon 2011c). Nagorsen and Brigham (1993) reported no bat hibernacula north of 52°N in British Columbia. Hibernating bats have not been found in Yukon and it is unlikely bats overwinter (Slough and Jung 2008). However, Humphries et al. (2002) predicted that current climatic conditions are suitable for Little Brown Myotis hibernation in the extreme southern Yukon (Slough and Jung 2008).

During acoustic bat surveys conducted for baseline surveys in August 2014, Little Brown Myotis was detected on all four nights of the survey within the Yukon River valley (Coffee camp location; 430 m elevation) but was not detected at the proposed Mine Site (Latte location; 1105 m elevation), which was active for six nights. Previous studies in Yukon have found that Little Brown Myotis is generally found below 1,000 m in elevation (Slough and Jung 2008), which is consistent with the lack of detections in the Latte area. No other bat species were detected during the investigations and based on existing knowledge no other species are expected within the W-RAA (Wildlife Baseline Report, **Appendix 16-A;** Wildlife Field Program Report, **Appendix 16-D**).

Based on the detection of Little Brown Myotis at the Coffee camp survey location, and previous records of Little Brown Myotis near Dawson (Slough and Jung 2008), the species is expected to be present, in low numbers, in suitable, low-elevation habitats throughout the W-RAA. Little Brown Myotis are most likely to interact with Project infrastructure and activities during the summer months in areas with potential for roost sites or foraging habitat. Foraging habitats are generally found within 500 m of water (Slough and Jung 2008) and include wetland, riparian, lacustrine, shoreline, and, to a lesser degree, forested habitats (Slough and Jung 2008; Holroyd et al. 2016). Roosting habitat is expected to be the most limiting factor within the W-RAA. Potential roosting habitat includes tree cavities, rock crevices on cliffs, caves, mines, under the bark of trees and on man-made structures. Therefore important habitat for Little Brown Myotis roosting includes cliff areas, rock complexes, caves and old forest. Anthropogenic features such as camps or homesteads containing buildings as well as rock outcrops and old forest are habitats that are mapped in baseline data and may have roosting potential for Little Brown Myotis. However, only a small fraction of this area is likely to contain the site-specific features required for roosting. Because specific roosting features such as tree cavities, rock crevices, caves and under the bark of trees, are difficult to identify at a broad-scale, old forest below 1,000 m in elevation is used as a surrogate for potential roosting habitat (Wildlife Baseline Report, **Appendix 16-A)**. This habitat type often contains roosting features like tree cavities and thick tree bark that bats can climb under. Old forest, especially stands within close probity to water and foraging habitat, and cliffs with crevices along the Yukon and Stewart rivers likely provide the greatest potential for bat roosting opportunities in the Project area.

4.0 ASSESSMENT OF PROJECT-RELATED EFFECTS

This section evaluates potential Project-related interactions with Wildlife and Wildlife Habitat, identifies the adverse effects potentially associated with those interactions, describes mitigation measures that will be implemented to eliminate, reduce, or otherwise control the effects, and identifies and evaluates residual effects, including their significance. The assessment of effects involved the following steps:

- **Section 4.1**: Identification of potential Project-related interactions with Wildlife and Wildlife Habitat
- **Section 4.2**: Introduction to potential Project-related effects on Wildlife and Wildlife Habitat
- **Section 4.3**: Identification of mitigation measures relevant to all Wildlife and Wildlife Habitat subcomponents
- **Section 4.4**: For each subcomponent, an assessment of potential effects, subcomponent specific mitigation measures, residual effects, and a summary of Project-related residual effects.

4.1 POTENTIAL PROJECT-RELATED INTERACTIONS WITH WILDLIFE AND WILDLIFE HABITAT

Each potential interaction between Wildlife and Wildlife Habitat and Project activities was considered and rated as No Interaction, Negligible Interaction, or Potential Interaction (defined in **Table 4.1-1**), and described in detail for each Project component in **Table 4.1-2**. Available TK was incorporated into the overview of potential interactions. For example Bates and DeRoy (2014) identified the following as potential Project-related interactions with Wildlife and Wildlife Habitat:

- *“Land clearing for Project operations and road construction potentially causing animal habitat destruction and fragmentation and limiting animal movement across the landscape*
- *Potential disturbance of animals due to noise and traffic during Project operation, causing them to move away from the area or change movement patterns*
- *Construction work on the Project bringing more people into the area, and familiarizing them with good hunting locations, which would potentially increase hunting pressure on wildlife populations.”*

Reviews of other projects on behalf of First Nations in Yukon (e.g., Campbell 2012) highlight concerns about the potential effects of low flying helicopter traffic on wildlife. Similar observations and concerns were noted in the TH Resource Report submitted to the Dawson Regional Land Use Planning Commission (Tr’ondëk Hwëch’in. 2012b). “*Helicopters disturb cows with calves*,” and “*Helicopters also disrupt wildlife*.” The same report quotes Elders as stating that “*…regardless of reclamation efforts, cannot mitigate the impacts of existing development projects anywhere in the traditional territory to the point that wildlife will not be affected.*”

Additional to identifying potential adverse effects, the TH Resource Report acknowledged the potential beneficial effects of some types of development. For instance, "… *certain activities like road building and placer mining can be beneficial to some species by encouraging new growth of food sources. Roads can be good for moose because new willow grows*" (Tr'ondëk Hwëch'in 2012b).

Table 4.1-1 Potential for an Interaction between Wildlife and Wildlife Habitat and the Project

Term	Definition
No Interaction	Project activity will not interact with Wildlife and Wildlife Habitat.
Negligible Interaction	Interaction with the Project activity will not have a substantive influence on the short or long-term integrity of Wildlife and Wildlife Habitat (i.e., not measurable / not detectable using the identified indicator(s)).
Potential Interaction	Interaction between the Project activity and Wildlife and Wildlife Habitat may have a substantive influence on the short- or long-term integrity of Wildlife and Wildlife Habitat (i.e., measurable or detectable using the identified indicator(s)). The potential effect(s) of the interaction is considered further in the effects assessment.

Table 4.1-2 Potential Project Interactions with Wildlife and Wildlife Habitat

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect on Wildlife
	#	Description		
Construction				
Overall Mine Site	C-0	Confirmatory geotechnical drilling in select areas at the mine site, as necessary	Potential interaction	Areas in which drilling will occur overlap spatially with wildlife habitat and adverse effects reduced use of adjacent habitat due to sensory disturbances (e.g., noise, equipment movement) while drills are mobilized and operating.
	C-1	Mobilization of mobile equipment and construction materials	Potential interaction	Adverse effects include potential increased mortality risk due to wildlife collisions with vehicles, and reduced use of adjacent habitat due to sensory disturbances from noise and movement associated with hauling.
	C-2	Clearing, grubbing, and grading of areas to be developed within the mine site	Potential interaction	Areas in which clearing will occur overlap spatially with wildlife habitat and adverse effects include loss of habitat within the footprint, reduced use of adjacent habitat due to sensory disturbances (e.g., noise, equipment movement, dust), and potential disruption to natural movement patterns due to habitat loss and sensory disturbances during clearing, grubbing and grading.
	C-3	Material handling	Potential interaction	Adverse effects include potential increased mortality risk due to wildlife collisions, and reduced use of adjacent habitat due to sensory disturbances from noise and movement associated with material handling.
Open Pits	C-4	Development of Latte pit and Double Double pit	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and operational activities related to development of the open pits.
	C-5	Dewatering of pits (as required)	No interaction	Areas in which activities occur overlap with wildlife habitat, but no Project-related changes to wildlife habitat or behaviour are anticipated from this activity.
Waste Rock Storage Facilities	C-6	Development and use of Alpha WRSF	Potential interaction	Areas in which this activity will occur overlap spatially with wildlife habitat and adverse effects include loss of habitat and reduced use of habitat due to sensory disturbances from operational activities at the facilities.
Stockpiles	C-7	Development and use of temporary organics stockpile for vegetation and topsoil	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances, like noise, from machinery operation during construction of the stockpile areas.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect on Wildlife
	#	Description		
	C-8	Development and use of frozen soils storage area	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances, like noise, from machinery operation during construction of the stockpile areas.
	C-9	Development and use of run-of-mine (ROM) stockpile for temporary storage of ROM ore	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances, like noise, from machinery operation during construction of the stockpile areas.
Crusher System	C-10	Construction and operation of crushing circuit	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances, like noise, from construction and operation of the crushing circuit.
	C-11	Construction and operation of crushed ore stockpile	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances, like noise, from construction and operation of the crushing circuit.
Heap Leach Facility	C-12	Staged heap leach facility (HLF) construction, including associated event ponds, rainwater pond, piping, and water management infrastructure	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and operational activities related to staged construction.
	C-13	Heap leach pad loading	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise associated with heap leach pad loading.
Plant Site	C-14	Construction and operation of process plant	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise associated with installation of process plant.
	C-15	Construction and operation of reagent storage area and on-site use of processing reagents	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and operational activities associated with construction of the storage area.
	C-16	Construction and operation of laboratory, truck shop, and warehouse building	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and operational activities associated with construction of the facilities.
	C-17	Construction and operation of power plant	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and operational activities associated with construction of the facilities.
	C-18	Construction and operation of bulk fuel/LNG storage and on-site use of diesel fuel or LNG	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and operational activities associated with construction of the facilities.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect on Wildlife
	#	Description		
Camp Site	C-19	Construction and operation of dormitories, kitchen, dining, and recreation complex buildings; mine dry and office complex; emergency response and training building; fresh (potable) water and fire water use systems; and sewage treatment plant	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and operational activities associated with construction of the facilities.
	C-20	Construction and operation of waste management building and waste management area	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and operational activities associated with construction of the facilities.
Bulk Explosive Storage Area	C-21	Construction of storage facilities for explosives components and on-site use of explosives	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from construction and blasting noise and operational activities associated with construction of the facilities.
Mine Site and Haul Roads	C-22	Upgrade, construction, and maintenance of mine site service roads and haul roads	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from dust, noise and movement associated with road servicing.
Site Water Management Infrastructure	C-23	Development and use of sedimentation ponds and conveyance structures, including discharge of compliant water	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and operational activities related to development of ponds and conveyance structures.
	C-24	Initial supply of HLF process water	No interaction	Areas in which activities occur overlap with wildlife habitat, but no Project-related changes to wildlife habitat or behaviour are anticipated from this activity.
	C-25	Ongoing use of site contact water (i.e., precipitation, stored rainwater) as HLF process water	No interaction	No Project-related changes to wildlife habitat or behaviour are anticipated from this activity within the footprint of the Mine Site.
Ancillary Components	C-26	Upgrade of existing road sections for Northern Access Route (NAR), including installation of culverts and bridges	Potential interaction	Areas in which upgrades will occur overlap spatially with wildlife habitat and adverse effects include loss of habitat within the footprint, reduced use of adjacent habitat due to sensory disturbances (e.g., noise, movement, dust), and potential disruption to natural movement patterns due temporary barriers and sensory disturbances during upgrading activities.
	C-27	Construction of new road sections for NAR, including installation of culverts and bridges	Potential interaction	Areas in which new construction will occur overlap spatially with wildlife habitat and adverse effects include loss of habitat within the footprint, reduced use of adjacent habitat due to sensory disturbances (e.g., noise, movement, dust), and potential disruption to natural movement patterns due to barriers and sensory disturbances during construction activities.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect on Wildlife
	#	Description		
	C-28	Development, operation, and maintenance of temporary work camps along road route	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and activities associated with construction and presence of the camp. Potential reduced use of site-specific features such as mineral licks or game trails.
	C-29	Vehicle traffic, including mobilization and re-supply of freight and consumables	Potential interaction	Adverse effects include potential increased mortality risk due to wildlife collisions, and reduced use of adjacent habitat due to sensory disturbances from noise and movement associated with road traffic.
	C-30	Development, operation, and maintenance of barge landing sites on Yukon River and Stewart River	Potential interaction	Areas in which development and operation will occur overlap spatially with wildlife habitat and adverse effects include loss of riparian habitat within the footprint, reduced use of adjacent habitat due to sensory disturbances (e.g., noise, movement) during construction and operation of the barge landings.
	C-31	Barge traffic on Stewart River and Yukon River, including barge mobilization of equipment for NAR construction	Negligible interaction	Infrequent sensory disturbance in habitat adjacent to Stewart and Yukon Rivers will not be a substantive influence on the short or long-term integrity on the habitat adjacent to the river.
	C-32	Annual construction, operation, maintenance, and removal of Stewart River and Yukon River ice roads	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise associated with annual construction, operation, maintenance and removal of ice roads on Stewart and Yukon rivers.
	C-33	Annual construction and operation of winter road on the south side of the Yukon River	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise associated with annual construction, operation, maintenance and removal of winter road.
	C-34	Construction, operation, and maintenance of permanent bridge over Coffee Creek	Potential interaction	Areas in which construction will occur overlap spatially with wildlife habitat and adverse effects include loss of habitat within the footprint, and reduced use of adjacent habitat due to sensory disturbances (e.g., noise, movement) during construction.
	C-35	Construction and maintenance of gravel airstrips	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from dust, noise and movement associated with construction and maintenance of gravel airstrip.
	C-36	Air traffic	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise on approach and take-off, dust, noise and movement associated with air traffic operations.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect on Wildlife
	#	Description		
	C-37	Use of all laydown areas	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and movement associated with with use of areas.
	C-38	Use of Coffee Exploration Camp	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and movement associated with with use of the camp.
Operation				
Overall Mine Site	O-1	Material handling	Potential interaction	Adverse effects include potential increased mortality risk due to wildlife collisions, and reduced use of adjacent habitat due to sensory disturbances from noise and movement associated with material handling.
	O-2	Excavation of contaminated soils followed by on-site treatment or temporary storage and off-site disposal	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise associated with excavation, and potential increased mortality risk from wildlife collisions associated with off-site transport for disposal.
	O-3	Progressive reclamation of disturbed areas within mine site footprint	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and operational activities related to reclamation activities.
Open Pits	O-4	Development of Kona pit and Supremo pit and continued development of Double Double pit and Latte pit	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and operational activities related to development of the open pits.
	O-5	Cessation of mining at Double Double pit, Latte pit, Kona pit, and Supremo pit	Negligible interaction	Considering that most effects on wildlife are realized during construction and development of the pits, there is likely reduced sensory disturbances in adjacent habitats as development activities (e.g., blasting, heavy equipment operation) are reduced during temporary and permanent closure.
	O-6	Partial backfill of Latte pit and Supremo pit	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and operational activities related to backfill of the open pits.
	O-7	Backfill of Double Double pit and Kona pit	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and operational activities related to backfill of the open pits.
	O-8	Dewatering of pits (as required)	No interaction	Areas in which activities occur overlap with wildlife habitat, but no Project-related changes to wildlife habitat or behaviour are anticipated from this activity.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect on Wildlife
	#	Description		
Waste Rock Storage Facilities	O-9	Continued development and use of Alpha WRSF	Potential interaction	Areas in which this activity will occur overlap spatially with wildlife habitat and adverse effects include loss of habitat and reduced use of habitat due to sensory disturbances from operational activities at the facilities.
	O-10	Development and use of Beta WRSF	Potential interaction	Areas in which this activity will occur overlap spatially with wildlife habitat and adverse effects include loss of habitat and reduced use of habitat due to sensory disturbances from operational activities at the facilities.
Stockpiles	O-11	Continued use of temporary organics stockpile for vegetation and topsoil	Potential interaction	Areas in which this activity will occur overlap spatially with wildlife habitat and adverse effects include reduced use of habitat due to sensory disturbances from operational activities at the stockpile.
	O-12	Continued use of frozen soils storage area	Potential interaction	Areas in which this activity will occur overlap spatially with wildlife habitat and adverse effects include reduced use of habitat due to sensory disturbances from operational activities at the storage area.
	O-13	Continued use of ROM stockpile for temporary storage of ROM ore	Potential interaction	Areas in which this activity will occur overlap spatially with wildlife habitat and adverse effects include reduced use of habitat due to sensory disturbances from operational activities at the stockpile.
Crusher System	O-14	Crusher operation	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances, like noise, from construction and operation of the crushing circuit.
	O-15	Continued use of crushed ore stockpile	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances like noise and dust associated with machinery activity during use of crushed ore stockpile
Heap Leach Facility	O-16	Continued staged HLF construction, including related water management structures and year-round operation	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and operational activities related to staged construction, addition of event pond and site activities.
	O-17	Progressive closure and reclamation of HLF	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances like noise, dust and movement from activities associated with closure and reclamation.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect on Wildlife
	#	Description		
Plant Site	O-18	Process plant operation	Nigligible interaction	The operation of the plant itself (e.g., regular activities within an enclosed structure), within the context of sensory disturbances associated with combined site activities, will not have an influence on use of adjacent habitats.
	O-19	Continued on-site use of processing reagents	Negligible interaction	Continued use of reagents within the constructed footprint of the Project will not interact with with wildlife.
	O-20	Continued on-site use of diesel fuel or LNG	Neglibible interaction	Continued use of fuel within the footprint of the Project will not interact with wildlife.
Camp Site	O-21	Continued use of facilities	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from blasting noise.
Bulk Explosive Storage Area	O-22	Continued on-site use of explosives	Potential interation	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from blasting noise.
Mine Site and Haul Roads	O-23	Use and maintenance of mine site service roads and haul roads	Potential interaction	Adverse effects include potential increased mortality risk due to wildlife collisions with vehicles, and reduced use of adjacent habitat due to sensory disturbances from noise and movement associated with traffic.
Site Water Management Infrastructure	O-24	Continued use of sedimentation ponds conveyance structures	Negligible interaction	Considering that most effects on wildlife are realized during construction of the conveyance structures within the footprint, their continued use has no interaction with wildlife in adjacent habitat.
	O-25	Ongoing use of site contact water (i.e., precipitation, stored rainwater) as HLF process water	No interaction	No Project-related changes to wildlife habitat or behaviour are anticipated from this activity within the footprint of the Mine Site.
	O-26	Installation and operation of water treatment facility for HLF rinse water	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and operational activities related to construction and operation of the water treatment facility.
Ancillary Components	O-27	NAR road maintenance (e.g., aggregate re-surfacing, sanding, snow removal)	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances (e.g., noise, movement, dust), and potential disruption to natural movement patterns due to seasonal barriers (e.g., snow banks).
	O-28	NAR vehicle traffic, including mobilization and re-supply of freight and consumables	Potential interaction	Adverse effects include potential increased mortality risk due to wildlife collisions, and reduced use of adjacent habitat due to sensory disturbances from noise and movement associated with road traffic.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect on Wildlife
	#	Description		
	O-29	Operation and maintenance of barge landing sites on Stewart River and Yukon River	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances (e.g., noise, movement) during operation and maintenance at the barge landings.
	O-30	Barge traffic on Stewart River and Yukon River	Negligible interaction	Infrequent sensory disturbance in habitat adjacent to Stewart and Yukon Rivers will not habitat a substantive influence on the short or long-term integrity on the habitat.
	O-31	Annual construction, operation, maintenance, and removal of Stewart River and Yukon River ice roads	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise associated with annual construction, operation, maintenance and removal of ice roads on Stewart and Yukon rivers.
	O-32	Annual construction and operation of winter road on the south side of the Yukon River	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise associated with annual construction, operation, maintenance and removal of winter road.
	O-33	Operation and maintenance of gravel air strips	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from dust, noise and movement associated with operation and maintenance of gravel airstrip.
	O-34	Air traffic	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise on approach and take-off, dust, noise and movement associated with air traffic operations.
	O-35	Use of all laydown areas	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and movement associated with with use of areas.
	O-36	Use of Coffee Exploration Camp	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and movement associated with with use of the camp.
Reclamation and Closure				
Overall Mine Site	R-1	Reclamation of disturbed areas within mine site footprint	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances like noise, dust and movement from activities associated with closure and reclamation of the Mine Site footprint. Positive effects include use of early successional habitats for foraging by wildlife.
	R-2	Excavation of contaminated soils followed by on-site treatment or temporary storage and off-site disposal	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances like noise, dust and movement from activities associated with excavation.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect on Wildlife
	#	Description		
Open Pits	R-3	Reclamation of Double Double pit, Latte pit, Supremo pit, and Kona pit	Negligible interaction	Considering that most effects on wildlife are realized during construction and development of the pits, there is likely reduced sensory disturbances in adjacent habitats as development activities (e.g., blasting, heavy equipment operation) are reduced.
Waste Rock Storage Facilities	R-4	Reclamation of Alpha WRSF	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances like noise, dust and movement from activities associated with reclamation.
	R-5	Reclamation of Beta WRSF	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances like noise, dust and movement from activities associated with reclamation.
Stockpiles	R-6	Reclamation of temporary organics stockpile, frozen soils storage area, and ROM stockpile	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances like noise, dust and movement from activities associated with reclamation and dismantling of stockpiles..
Crusher System	R-7	Dismantling and removal of crusher facility and stockpile	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances like noise, dust and movement from activities associated with dismantling and removal of the crusher.
Heap Leach Facility	R-8	Closure of HLF and related water management structures	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances like noise, dust and movement from activities associated with closure of the HLF and related structures.
Plant Site	R-9	Dismantling and removal of process plant, reagent storage area, laboratory, truck shop and warehouse building, power plant, and bulk fuel storage	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances like noise, dust and movement from activities associated with dismantling of the structure.
Camp Site	R-10	Dismantling and removal or dormitories and kitchen, dining, and recreation complex buildings, mine dry and office complex, emergency response and training building, fresh (potable) water and fire water systems, sewage treatment plant, and waste management building	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances like noise, dust and movement from activities associated with dismantling and removal.
Bulk Explosive Storage Area	R-11	Dismantling and removal of explosives storage facility	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances like noise, dust and movement from activities associated with dismantling and removal.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect on Wildlife
	#	Description		
Mine Site and Haul Roads	R-12	Decommissioning and reclamation of mine site service roads and haul roads	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances like noise, dust and movement from activities associated with decommissioning and reclamation of roads.
Site Water Management Infrastructure	R-13	Decommissioning and reclamation of selected water management infrastructure, construction of long-term water	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances like noise, dust and movement from activities associated with decommissioning of infrastructure, construction on long term infrastructure.
	R-14	Operation and maintenance of HLF water treatment facility	Negligible interaction	The operation of the facility itself (e.g., regular activities within an enclosed structure) will not have an influence on use of adjacent habitats.
	R-15	Decommissioning and removal of HLF water treatment plant	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances like noise, dust and movement from activities associated with dismantling and removal.
Ancillary Components	R-16	NAR road maintenance (e.g., aggregate re-surfacing, sanding, snow removal)	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances (e.g., noise, movement, dust), and potential disruption to natural movement patterns due to seasonal barriers (e.g., snow banks).
	R-17	NAR vehicle traffic	Potential interaction	Adverse effects include potential increased mortality risk due to wildlife collisions, and reduced use of adjacent habitat due to sensory disturbances from noise and movement associated with road traffic.
	R-18	Operation and maintenance of barge landing sites on Stewart River and Yukon River	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances (e.g., noise, movement) during operation and maintenance at the barge landings.
	R-19	Annual resupply of consumables and materials for active closure via barge on the Yukon River	Negligible interaction	Infrequent sensory disturbance in habitat adjacent to Stewart and Yukon Rivers will not habitat a substantive influence on the short or long-term integrity on the habitat.
	R-20	Annual construction, maintenance, and decommissioning of Stewart River and Yukon River ice roads	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise associated with annual construction, operation, maintenance and removal of ice roads on Stewart and Yukon rivers.
	R-21	Decommissioning of new road portions	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances like noise, dust and movement from activities associated with decommissioning of road.

Project Component	Project Activities		Interaction Rating	Nature of Interaction and Potential Effect on Wildlife
	#	Description		
	R-22	Air traffic	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise on approach and take-off, dust, noise and movement associated with air traffic operations.
	R-23	Decommissioning and reclamation of airstrip	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances like noise, dust and movement from activities associated with decommissioning of airstrip. Longer-term benefit of early seral stage habitats for foraging.
	R-24	Re-opening and operation of pre-existing Yukon River exploration camp and airstrip to support post-closure monitoring activities	Potential interaction	Adverse effects include reduced use of adjacent habitat due to sensory disturbances from noise and movement associated with with use of the camp.
Post-Closure				
Overall Mine Site	P-1	Long-term monitoring	Negligible Interaction	Occasional presence of humans on site will have an adverse effect on some wildlife due to sensory disturbance (e.g., movement, noise).

4.2 POTENTIAL PROJECT-RELATED EFFECTS

Potential Project-related adverse effects on Wildlife and Wildlife Habitat were identified based on Project-related interactions (**Table 4.1-2**). More specific descriptions of these potential effects are described below as they relate to the subcomponents Fortymile Caribou, Klaza Caribou, Moose, Thinhorn Sheep, Grizzly Bear, Wolverine, and Little Brown Myotis. Potential effects that only relate to some of these subcomponents are identified. Effects assessments are summarized specifically for each subcomponent in **Section** 4.4.

4.2.1 HABITAT LOSS

Habitat will be lost from the ground clearing and vegetation removed within the Project footprint during the Construction phase and the continued development of Waste Rock Storage Facilities (WRSFs) during the Operation phase. Habitat loss is considered an effect on all Wildlife and Wildlife Habitat subcomponents. The assessments completed for each subcomponent focuses on specific habitats and consider seasonal and life requisites that could interact with the Project (discussed further in **Section 4.4**.).

Note: Since the assessment of Project effects to Wildlife and Wildlife Habitats was completed, minor shifts in the location of Project infrastructure at the proposed Mine Site have occurred. The final Project footprint differs from the assessed footprint by:

- 0.26 km² assessed as loss no longer overlap the Project footprint
- 1.73 km² not assessed as loss are now located within the footprint.

The affected areas overlap the boreal high – subalpine transition zone and are primarily located within zonal and nutrient poor sites dominated by scrub birch, black spruce, white spruce and other shrub species. Review by VC report authors indicated that the minor shifts in Project infrastructure would not alter the Project effects assessment in any meaningful way for any of the Wildlife Subcomponents assessed.

4.2.2 REDUCED HABITAT EFFECTIVENESS

Reduced habitat effectiveness due to sensory disturbance (e.g., noise, movement, dust, emissions, air, road, and barge traffic) may result in avoidance of areas adjacent to the Project footprint or may increase the risk of stress to animals using the habitat. Reduced habitat effectiveness is a potential effect for all Wildlife and Wildlife Habitat subcomponents and may occur during Construction, Operation, and Reclamation and Closure phases when on-site Project activities are occurring. Reduced habitat effectiveness is relevant to certain seasons and life requisites, depending on species. For example, Caribou herds are known to occur in the assessment areas in specific seasons (e.g., Fortymile Caribou in winter). Little Brown Myotis is known to use very specific habitat features for roosting (e.g., under loose bark of mature trees). The consequence of reduced use of less effective habitat in proximity to disturbance was quantified for subcomponents and summarized in **Section 4.4**.

4.2.3 MORTALITY RISK

Mortality risk due to collisions with Project-associated vehicles on Mine Site roads and the NAR is considered a potential effect on Wildlife and Wildlife Habitat subcomponents as most species have the potential to encounter vehicles. Since vehicles will be in use for the majority of the Project life, mortality risk is a potential effect during Construction, Operation, and Reclamation and Closure phases. Mortality risk may also increase as a result of increased hunter access. Risk of entrapment of wildlife in Project facilities such as in event ponds or open pits is also considered in this potential effect.

4.2.4 ALTERATION TO MOVEMENT

Project infrastructure may present a physical or sensory partial barrier or filter to natural patterns of animal movement through or to important habitat. This potential effect may occur during the Construction, Operations, Closure and Reclamation phases and applies to all subcomponents except Klaza Caribou and Little Brown Myotis. The KCH does not show identified directional movement, particularly at the periphery of their range where they may interact with the Project, so alteration to movement is not considered. Alteration of Little Brown Myotis movement patterns due to the Project was considered negligible because buildings and other infrastructure are not expected to interact with localized foraging flights.

4.2.5 CONTAMINANTS UPTAKE

Contaminants uptake and risk of illness or mortality from foraging at the Mine Site, or ingesting dust-covered forage is a potential effect that may occur during all Project phases. This potential effect is relevant to plant foraging species such as Fortymile Caribou, Klaza Caribou, Moose, Grizzly Bear, and Thinhorn Sheep.

4.3 MITIGATION MEASURES

Mitigation measures comprise any practical means taken to manage potential adverse effects on Wildlife and Wildlife Habitat and may include applicable standards, guidelines, and Best Management Practices/Plans (BMPs) supported by specific guidance documents. The mitigation measures identified for Wildlife and Wildlife Habitat were informed by a review of mitigation and follow-up programs undertaken for past projects, with emphasis on mining projects in Yukon. Input was received through the consultation and engagement process described previously. The TH provided input (N. Becker, Pers. Comm. 2016) on the Wildlife Protection Plan (WPP; **Appendix 31-F**), which is a key conceptual plan that directs how mitigation will be implemented for the Project. The WPP details the main mitigation measures and compliance and follow-up monitoring relevant to reducing effects on Wildlife and Wildlife Habitat. The WPP will be used and updated as an operational document during all Project phases.

The mitigation measures identified in the following documents also have components that are relevant to minimizing effects on Wildlife and Wildlife Habitat:

- Conceptual Reclamation and Closure Plan (**Appendix 31-C**) — provides guidance and best practices for revegetation and reclamation of habitat for future wildlife use, including the removal of infrastructure, waste rock pile re-contouring, and decommissioning of settling ponds, ditches, and roads.
- A dust management plan will include controls on dust that might settle on vegetation used as habitat for wildlife. Those measures will reduce effects to habitat adjacent to the Project footprint.
- Access Route Construction (**Appendix 31-A**) and Operational (**Appendix 31-B**) Management Plans — provides details on the construction and operations of the NAR including mitigation and monitoring for dust control measures, and habitat management along the proposed road alignment. Also includes traffic management measures to reduce mortality risk related to vehicle collisions with wildlife.
- A fish and aquatic habitat management plan will provide information on mitigation and management measures to reduce effects to fish and aquatic habitat. Measures to protect fish and aquatic habitat will benefit wildlife (e.g. Moose, Little Brown Myotis) that use riparian habitat.
- A noise management plan will provide information on mitigation and management measures and a noise monitoring plan to reduce Project-associated noise which will avoid unnecessary potential disturbance to wildlife.
- A spill contingency plan will provide information on operational procedures and mitigation and management measures to avoid spills, thus minimizing contamination to wildlife habitat.
- A vegetation management plan will information on the mitigation measures and monitoring relevant to reducing effects on vegetation which is used as habitat for wildlife.
- A waste management plan will provide information on waste management related to the Project landfill and management procedures for storing and disposing of waste and reducing effects to wildlife that are attracted to these areas.

To inform the Proponent, First Nations, regulators, and stakeholders about mitigation effectiveness and Project effects, the mitigation framework is supported by a Project effects monitoring framework, described in **Section 8.0** with details provided in the WPP (**Appendix 31-F**).

The Proponent recognizes that there will be disturbances and effects on Wildlife and Wildlife Habitat as a result of Construction, Operation, and Reclamation and Closure of the Project. To reduce or eliminate potential Project effects on Wildlife and Wildlife Habitat, the Proponent commits to a number of mitigation measures. Each of the following subsections summarizes the pertinent mitigation measures with reference to relevant management or protection plans that describe how the mitigation will be implemented. When relevant, a description of the feasibility of the mitigation measure, including its suitability for Project, its site-specific application and its expected effectiveness is provided. When possible, supporting evidence, how long it will take to become effective, any associated uncertainty, and the potential risks and consequences if the mitigation measure is not effective are also identified.

4.3.1 PROJECT DESIGN

Mitigation through project design is one of several approaches the Proponent is proposing to eliminate, reduce, or control potential effects. Many potential effects on Wildlife and Wildlife Habitat are addressed by Project design. Design elements with direct relevance to mitigating potential Project effects on Wildlife and Wildlife Habitat are: Project siting to avoid habitat loss and to minimize reduced habitat effectiveness; use of a heap leach facility (HLF); progressive reclamation; selective siting of WRSFs; road design; measures to minimize vehicle traffic; and an approach to waste management that, by limiting wildlife attractants, decreases the risk of scavenging, contaminant uptake, and entrapment.

Project Siting

- To minimize habitat loss, the Mine Site footprint is designed to be as small as possible. Examples of considerations to minimize the footprint include the backfill of pits and WRSF design.
- To minimize disturbance to wildlife, where Project design allows, infrastructure areas, laydown areas and borrow sources will be constructed away from important habitat features (e.g., mineral licks, dens) and identified environmentally sensitive areas (e.g., wetlands).
- The construction and use of a new airstrip on the subalpine ridge near the Mine Site will minimize disturbance to high value wildlife habitats in the Yukon River valley.

Heap Leach Facility

- A smaller footprint will reduce direct habitat loss to wildlife and will minimize reduced habitat effectiveness.
- To prevent process solution (contact water) affecting wildlife habitat retained in the Project footprint, a redundant system of liners, drainage layers, leak detection and monitoring systems will be in place (refer to the Water Management Plan, **Appendix 31-E**).

Progressive Reclamation

- Progressive reclamation and closure activities will begin as early as Year 2 and continue throughout the mine life. An early and progressive approach to reclamation will reduce the duration of direct habitat loss and sensory disturbance to wildlife.
- Natural vegetation will be maintained where possible to minimize direct habitat loss and limit erosion and sedimentation. Retained vegetation also decreases the amount of reclamation required at closure.

Waste Rock Storage Facilities

- WRSF sites were selected to minimize haul distances and extent of ground disturbance.
- Minimizing haul distance will reduce the risk of mortality to wildlife caused by vehicles. It will reduce the level of dust and noise, thereby minimizing reduction to habitat effectiveness.

Road Design and Traffic

- The road embankment profile will be minimized (i.e., shorter and shallower), where possible, to minimize the potential for the road to filter, or act as a barrier, to wildlife movements.
- Wildlife crossings will be constructed where the road surface is raised above the surrounding area (more than 2 m high) and either the raised surface extends for more than 500 m.
- Where possible, roads will be designed with clear lines of sight to increase the ability of drivers to see wildlife before it becomes a collision hazard.
- To minimize wildlife habitat loss and not increase human (harvester) access to the area, existing roads will be used to the extent possible. Where possible, new roads will be designed to avoid important wildlife habitat features and sensitive habitats.
- The NAR will be designed for speeds of 50 km/hr. Traffic volume and speed are strongly correlated with wildlife collision rates (Bishop and Borgan 2013). Operating vehicle traffic at low levels (e.g., eight truck loads per day) and setting speed limits will effectively minimize the risk of vehicle collisions.
- Most personnel will operate on two week on/two week off-shift rotation on a fly-in/fly-out basis, which will minimize vehicle traffic along the road.
- As per the Access Route Operational Management Plan (**Appendix 31-B**), operations along the NAR will shut down for the fall freeze-up suspension period (approximately six week closure, November to December) and the spring thaw suspension period (approximately four week closure, April to May). These closures will help minimize effects to wildlife during the spring and fall seasons.

Waste Management

- Incineration and recyclable sorting of materials that could pose as attractants to wildlife (e.g. food waste, beverage containers), will occur in a designated and contained waste management area, that will either be housed in a building or surrounded by animal-proof fencing.
- Food waste will be incinerated daily or composted in a fashion that does not attract wildlife.
- Only non-hazardous, non-leaching, inorganic garbage will be disposed of in on-site landfill or where practical, transported off site for recycling.
- Sewage will be treated by an enclosed membrane bioreactor (MBR) plant. Sludge will be disposed of in a fashion that does not attract wildlife.

The anticipated level of success of Project design mitigation measures is high because these measures avoid and eliminate pathways for potential effects which is the most effective approach for mitigation.

4.3.2 PROJECT PERSONNEL WILDLIFE AWARENESS ORIENTATION

Project personnel wildlife awareness programs will increase awareness of The Proponent's commitment to the protection of Wildlife and Wildlife Habitat. Wildlife awareness orientation will be provided to all workers on the site through all phases of the Project. A wildlife sighting log will be maintained by on-site personnel through all Project phases. The objectives of the wildlife awareness orientation will be as follows:

- Provide workers with knowledge of why interactions with wildlife are important to manage.

- Provide workers with an understanding of the course of action to be taken in a variety of circumstances.
- Emphasize the role of adaptive management in realizing effective mitigation for wildlife and the workers' role in recording their observations on the wildlife sighting log, or as part of the monitoring programs described in the WPP (**Appendix 31-F**).

The anticipated probability of success of this mitigation measure is high. Creating awareness of wildlife is recommended by EC (EC 2013) and is known to be effective because it strengthens the level of anticipated success of all other mitigation measures that rely on site personnel for successful implementation. Orientation for Wildlife and Wildlife Habitat can be incorporated into health and safety site orientation and records will be kept to document completion of the orientation by all site personnel.

4.3.3 MINIMIZE HABITAT DISTURBANCE

Habitat disturbance results from vegetation clearing, ground disturbance, and Project-related activities that occur adjacent to wildlife habitat. Minimizing clearing and ground disturbance as much as practicable within the Project footprint, maintaining key habitat features and observing least risk timing windows for construction (refer to the WPP, **Appendix 31-F**) will reduce habitat disturbance. Key features such as bear or other wildlife dens, wildlife trees, or mineral licks discovered during the life of the Project may require specific disturbance management protocols such as no-disturbance buffers. These mitigation measures will apply to Construction, Operation, and Reclamation and Closure phases. The following specific measures described in the WPP and various management plans, will be applied:

- Construction will adhere to wildlife timing windows to avoid sensitive habitats during sensitive times (refer to the WPP, **Appendix 31-F**).
- No-disturbance buffers will be established around identified wildlife habitat features (e.g., mineral licks, dens, and bat roosts) during sensitive periods (refer to the WPP for more details). Project activities, including blasting, will consider the potential for disturbance to nearby wildlife features. If disturbance within a no-disturbance buffer is unavoidable, the Proponent's Environment Department will develop site-specific protection measures in consultation with authorities.
- Pre-clearing surveys for bat roosts will be conducted in habitats with a high potential to support bat roosts prior to the commencement of construction activities. Any identified bat roosts will be left structurally intact and a no-disturbance buffer will be established around active roosts.
- Project activities will minimize noise emissions where possible to, in part, avoid unnecessary potential disturbance to wildlife.
- Project activities will manage dust emissions to reduce fugitive dust generation and its potential to settle on adjacent wildlife forage plants. Reducing effects to adjacent vegetation involves controls on dust and emissions that may settle on plants and either affect plant growth and productivity, cause changes in plant community composition, or increase the probability of metals uptake in some plants, which can also affect Wildlife and Wildlife Habitat.

- The south-facing slopes above the Yukon River are known to support Thinhorn Sheep year-round. Road construction will be timed to minimize activity near the Yukon River cliffs during the lambing season.
- To minimize disturbance to migrating Caribou, during the FMCH spring and fall migration seasons, a phased approach to mitigation will be followed. Mitigation will be triggered by increasing proximity of collared Caribou and/or the observations of large groups of Caribou (i.e., > 200; WPP).

The anticipated level of success of this mitigation measure is partial because it is unlikely to be feasible to protect all potential features or minimize all disturbances.

4.3.4 Reduce Human-Wildlife Encounter Risks

In addition to measures included in Project design with respect to waste management, the Proponent will implement the following additional measures to minimize human-wildlife interactions and conflicts, reducing wildlife mortalities:

- Where practical, buildings will be designed to discourage use by wildlife and prevent human-wildlife conflicts:
  - All buildings and stair landings will be skirted to the ground to discourage wildlife access under buildings.
  - Windows will be installed on all exits to allow personnel to look for wildlife before exiting the building.
- Bear-proof garbage cans will be located outside buildings in high traffic areas for the collection of general waste.
- Items disposed of in the onsite landfill will be restricted to materials which should not act as wildlife attractants; however, the landfill will be monitored for wildlife and if wildlife are found to frequent the landfill, an electric fence will be place around the landfill.
- Workers will be trained in wildlife management protocols, including garbage management and bear encounter protocols.
- Periodic audits will be conducted to assess the effectiveness of waste management practices and regular surveillance of Project facilities and waste disposal sites will ensure that wildlife control measures are effective.
- Waste management will be strictly enforced with the implementation of a waste management plan.

The anticipated level of success is high considering that the majority of risk is addressed through Project design by daily incineration or contained composting of food waste and containment of domestic wastewater and sewage sludge.

4.3.5 Wildlife Protection Protocols

Implementation of wildlife protocols will reduce the potential for wildlife-human interactions in the Project footprint, and will help ensure employee safety while minimizing potential wildlife mortalities.

- Hunting of wildlife will be prohibited at all times for all employees and contractors while present on site (both on and off-shift).
- Feeding of wildlife will be prohibited. Harassing or approaching wildlife will be prohibited.
- Warning signs will be posted in areas of frequent wildlife encounters on a seasonal basis or as otherwise required.
- Employees will be required to report wildlife sightings along the road and near Project facilities. The Environment Department will be responsible for tracking all wildlife observations.
- Reporting and documentation of all wildlife mortalities and near misses will be mandatory, and a follow-up investigation will be conducted for all mortality events.
- In the event of bear encounters, several types of bear deterrents will be employed, including bear spray,air horns and if warranted, projectile deterrents (bangers, rubber bullets or bean bags). Firearms will only be used as a last resort in the event of a bear encounter when all other methods of bear deterrents have failed. Yukon Conservation Services will be consulted if nusance animals become a concern. If animals are killed in defense of life or property, Yukon Conservation Services will be consulted regarding disposal.

4.3.6 MANAGE TRAFFIC

Additional to the reduced effects associated with low traffic volume and low speed limits that are part of the Project design (**Section 4.3.1**), further measures to manage traffic will minimize sensory disturbance and mortality risk from wildlife collisions with vehicles. Temporary road closures (i.e., closures at certain times of day) and/or traffic restrictions (e.g., speed restrictions) may be implemented as required to mitigate adverse effects to Wildlife and Wildlife Habitat.

The following mitigation measures will be in place to minimize mortality risk from collisions (refer to the WPP, **Appendix 31-F**, for further details):

- Wildlife will have the right-of-way along all Project roads:
  - Vehicle operators will be vigilant to watch for wildlife near roads, and will take all reasonable actions to avoid collisions with wildlife.
  - If wildlife are observed on the road, traffic must stop as far back as safely possible. If after five minutes the animals have not moved off the road, the vehicle may proceed slowly and cautiously (less than 20 km/h). An operational decision tree matrix for drivers dealing with wildlife along Project roads is provided in the WPP.
- Road signage, both permanent and temporary, will be erected to inform users regarding seasonal wildlife issues along the NAR and Mine Site roads as necessary.
- Speed limits will be posted along the NAR, including additional speed restrictions for the protection of wildlife along specific sections of road and/or during seasons when wildlife are expected to regularly interact with the road.
- The maximum speed limit along all Project roads will be 50 km/h, and speeds may be monitored by on-board GPS reporting or by other means.

- Temporary road closures and/or traffic restrictions will be implemented as determined to be required to minimize effects to wildlife during sensitive periods including moose congregation areas in the post-rut and early winter, and caribou migration. Temporary road closures and/or traffic restrictions will be determined as outlined in the WPP.
- During the Fortymile Caribou spring and fall migration seasons, a phased approach to mitigation will be followed. Mitigation will be triggered by increasing proximity of collared Caribou and/or the observations of large groups of Caribou (i.e., > 200 Caribou; WPP). Temporary road closures may be required when large groups of Caribou are migrating through the area. Depending on the size of the movements, speed restrictions and stopping may be sufficient to allow for continued Caribou movement.
- To limit public access to the area, the Proponent will control access at the Stewart and Yukon rivers crossings. This mitigation measure is likely to include:
    - Access control at the north entrance at each of the Stewart and Yukon River barge landing areas. Access will not be prevented to current barge landings along the Stewart or Yukon rivers.
    - Only authorized, mine-related vehicles will be permitted on Proponent-operated barges and ice bridges on the Stewart and Yukon rivers.

Monitoring and Adaptive Management will be conducted as described in **Section 8.0**. For instance, drivers will be required to report all wildlife collisions and near misses to the Proponent's Environment Department. All collisions and near misses will be investigated to determine the root cause and identify any corrective actions to prevent future occurrences.

4.3.7 Reduce Barriers to Movement

In addition to the Project design elements (**Section 4.3.1**) that will minimize barriers to movement (e.g. road embankment heights) the following measures will be used to minimize physical barriers to wildlife attempting to cross the road, and sensory disturbances along the road.

- Where safe to do so and allowed by other design considerations, snow banks will be managed, and maintained to less than 1 m high over long continuous sections and will include periodic breaks to ensure escape opportunities to minimize potential barrier effects on wildlife movements.
- Where practical and possible, special care will be taken so that road construction and operation through the Thinhorn Sheep Ballarat occurrence area will minimize hindrance to Sheep crossing the road. Specifically:
    - Minimize tall, steep road banks
    - Snow clearing and piling in a way that will minimize hindrance to Sheep crossing the road.

4.3.8 Manage Aircraft Operations

Aircraft operations, including both fixed-wing aircraft and helicopters, will be managed to limit the potential effects to wildlife. Subject to safety considerations:

- All Project-related aircraft will maintain a minimum cruising altitude of 300 m above ground level; between May 1 and June 30 the minimum cruising altitude will be increased to 600 m above ground level when Caribou have been identified in the area (for the protection of calving Caribou).
- Hovering or circling over wildlife may greatly increase disturbances and will be avoided.
- For the protection of Thinhorn Sheep, aircraft will maintain a cruising altitude of 500 m above ground when flying over the south-facing slopes along the Yukon River, or maintain a horizontal distance of at least 1,000 m from these slopes.
- Exceptions: low level flights will be permitted during wildlife surveys, as directed by Project biologists in accordance with wildlife research permits. Safety considerations relating to weather conditions or other aircraft may also require deviation from preferred flight paths or elevations.

4.3.9 Prevent Wildlife Entrapment

The risk of wildlife mortality resulting from interactions with Mine Site infrastructure was considered during Project design. To limit the potential for wildlife entrapment in Mine Site infrastructure, several design elements and mitigation measures were developed.

- Heap Leach Facility event ponds will be fenced during Operation to prevent access by wildlife.
- Where open pits could present a hazard to wildlife that is not readily apparent, where safe to do so, efforts will be made to limit the risk by placing boulders or creating berms to prevent access to the edges of the pit such that any approaching wildlife would be forced to slow down and recognize the risk.
- During Reclamation and Closure and Post-closure, access roads into the open pits will be maintained to avoid potential for wildlife entrapment within the pits.

Monitoring of wildlife occurrence near potential entrapment areas will be conducted and mitigation could change to better adapt to occurrences and risk as described in **Section 8.0**.

4.3.10 Summary of Mitigation Measures

Table 4.3-1 provides a summary of mitigation measures that will minimize potential adverse Project-related effects on Wildlife and Wildlife Habitat.

Table 4.3-1 Summary of Potential Effects and Proposed Mitigation Measures for Wildlife and Wildlife Habitat

Summary of Potential Effect	Contributing Project Activities	Proposed Mitigation Measure	Applicable Subcomponent	Detectable / Measurable Residual Effect (Yes/No)
Construction Phase				
Habitat Loss	Clearing, grubbing, and grading, Upgrade of existing road and construction of new road sections	• Project Design • Minimize Habitat Disturbance	• Fortymile Caribou • Klaza Caribou • Moose • Thinhorn Sheep • Grizzly Bear • Wolverine • Little Brown Myotis	Yes
Reduced Habitat Effectiveness	All activities causing noise, movement, dust emissions, etc. (e.g., personnel movement; clearing, grubbing, and grading activities within the Project footprint; upgrades of existing sections and construction of new sections along the NAR; general road use and maintenance)	• Project Personnel Wildlife Awareness Orientation • Minimize Habitat Disturbance • Wildlife Protection Protocols • Manage Traffic • Manage Aircraft Operations	• Fortymile Caribou • Klaza Caribou • Moose • Thinhorn Sheep • Grizzly Bear • Wolverine • Little Brown Myotis	Yes
Mortality Risk	Human presence, moving machinery	• Project Design • Project Personnel Wildlife Awareness Orientation • Reduce Human-Wildlife Encounter Risks • Wildlife Protection Protocols • Manage Traffic • Prevent Wildlife Entrapment	• Fortymile Caribou • Moose	Yes
			• Klaza Caribou • Thinhorn Sheep • Grizzly Bear • Wolverine • Little Brown Myotis	No

Summary of Potential Effect	Contributing Project Activities	Proposed Mitigation Measure	Applicable Subcomponent	Detectable / Measurable Residual Effect (Yes/No)
Alteration to Movement	Construction of NAR	• Project Design • Project Personnel Wildlife Awareness Orientation • Manage Traffic • Reduce Barriers to Movement	• Fortymile Caribou • Thinhorn Sheep	Yes
			• Klaza Caribou • Moose • Grizzly Bear • Wolverine • Little Brown Myotis	No
Operation Phase				
Reduced Habitat Effectiveness	All activities causing noise, movement, dust emissions, etc. (e.g., personnel movement; clearing, grubbing, and grading activities within the Project footprint; general road use and maintenance)	• Project Personnel Wildlife Awareness Orientation • Minimize Habitat Disturbance • Wildlife Protection Protocols • Manage Traffic • Manage Aircraft Operations	• Fortymile Caribou • Klaza Caribou • Moose • Thinhorn Sheep • Grizzly Bear • Wolverine • Little Brown Myotis	Yes
Mortality Risk	Human presence, moving machinery, entrapment, traffic, unmanaged harvester access	• Project Design • Project Personnel Wildlife Awareness Orientation • Reduce Human-Wildlife Encounter Risks • Wildlife Protection Protocols • Manage Traffic • Prevent Wildlife Entrapment	• Fortymile Caribou • Moose	Yes
			• Klaza Caribou • Thinhorn Sheep • Grizzly Bear • Wolverine • Little Brown Myotis	No

Summary of Potential Effect	Contributing Project Activities	Proposed Mitigation Measure	Applicable Subcomponent	Detectable / Measurable Residual Effect (Yes/No)
Alteration to movement	Mine infrastructure and mine traffic, road infrastructure and road traffic	• Project Design • Project Personnel Wildlife Awareness Orientation • Manage Traffic • Reduce Barriers to Movement	• Fortymile Caribou • Thinhorn Sheep	Yes
			• Klaza Caribou • Moose • Grizzly Bear • Wolverine • Little Brown Myotis	No
Contaminants Uptake	Crushing and processing facilities Waste management facilities and disposal areas Traffic and fugitive dust	• Project Design • Project Personnel Wildlife Awareness Orientation • Reduce Human-Wildlife Encounter Risks	• Fortymile Caribou • Klaza Caribou • Moose	No
Reclamation and Closure Phase				
Reduced Habitat Effectiveness	All activities causing noise, movement, dust emissions, etc. (e.g., personnel movement; clearing, grubbing, and grading activities within the Project footprint; general road use and maintenance)	• Project Personnel Wildlife Awareness Orientation • Minimize Habitat Disturbance • Wildlife Protection Protocols • Manage Traffic • Manage Aircraft Operations	• Fortymile Caribou • Klaza Caribou • Moose • Thinhorn Sheep • Grizzly Bear • Wolverine • Little Brown Myotis	Yes
''Mortality Risk	Human presence, moving machinery, entrapment, traffic, unmanaged harvester access	• Project Design • Project Personnel Wildlife Awareness Orientation • Reduce Human-Wildlife Encounter Risks • Wildlife Protection Protocols • Manage Traffic • Prevent Wildlife Entrapment	• Fortymile Caribou • Moose	Yes
			• Klaza Caribou • Thinhorn Sheep • Grizzly Bear • Wolverine • Little Brown Myotis	No

Summary of Potential Effect	Contributing Project Activities	Proposed Mitigation Measure	Applicable Subcomponent	Detectable / Measurable Residual Effect (Yes/No)
Alteration to Movement	Mine infrastructure and mine traffic, road infrastructure and road traffic	• Project Design • Project Personnel Wildlife Awareness Orientation • Manage Traffic • Reduce Barriers to Movement	• Fortymile Caribou • Thinhorn Sheep	Yes
			• Klaza Caribou • Moose • Grizzly Bear • Wolverine • Little Brown Myotis	No
Contaminants Uptake	Traffic and fugitive dust emissions; landfill/waste management practices	• Project Design • Project Personnel Wildlife Awareness Orientation • Reduce Human-Wildlife Encounter Risks	• Fortymile Caribou • Klaza Caribou • Moose • Thinhorn Sheep • Grizzly Bear	No

4.4 RESIDUAL EFFECTS AND SIGNIFICANCE OF RESIDUAL EFFECTS

Project-related residual effects were assessed for each subcomponent based on potential interactions identified in **Table 4.1-2** with the indicators listed in **Table 1.2-3**. Following the successful implementation of the mitigation measures described in **Section 4.3** and the WPP (**Appendix 31-F**), the potential effect of contaminants uptake (**Section 4.2.5**) is not considered a residual effect for any subcomponent and is therefore not considered further in the assessment for the following reasons:

- Potential for wildlife to be exposed to metals or contaminants due to interactions with the Project is negligible. Possible pathways of exposure to contaminants include drinking of water from event ponds on the Mine Site and Project-related dust accumulation on vegetation consumed by wildlife. A number of mitigation measures will be implemented to limit the risk of contaminant exposure.
- Management plans will be in place for the Project, including a waste management plan and the Water Management Plan (**Appendix 31-E**) to limit the risk of exposure. Fencing will be used on the perimeter of the event ponds as necessary to prevent wildlife from drinking from the ponds if they contain contaminants. Project design will limit waste material in the landfill and on site through daily incineration of organic waste and containment of domestic waste. A dust management plan will identify several mitigation measures to reduce the likelihood of dust accumulating on vegetation near the Project. Mitigation measures associated with control of fugitive dust emissions along the NAR and Mine Site roads could include a requirement that haul trucks carrying potentially dust-generating materials cover their loads while in transit, as well as regular monitoring and management of road dust. On the Mine Site, material stockpiles will be designed and oriented to reduce wind erosion and material drop heights will be minimized to reduce dust emissions associated with ore handling. Trace metals sampling of vegetation will be addressed in a vegetation management plan. Mine contact water will be monitored for metals throughout the life of the mine. Results will be used to assess possible toxicity risk to wildlife and to develop adaptive management measures to further reduce the likelihood of exposure to or uptake of contaminants.

The assessments for specific residual effects of habitat loss and reduced habitat effectiveness, mortality risk, or alteration to movement is described in the subcomponent sections below.

4.4.1 RESIDUAL EFFECTS CHARACTERISTICS

Residual effects are characterized based on the criteria defined in **Table 4.4-1**. The characterization of residual effects was based on (when available) published regulatory or industry standards, non-regulated but widely-recognized standards, TK, and informed professional judgement.

Table 4.4-1 Effect Characteristics Considered When Determining the Significance of Residual Effects on Wildlife and Wildlife Habitat

Residual Effect Characteristic	Definition	Rating
Direction	Identifies whether the residual effect will be positive (e.g., a desirable effect) or adverse (an undesirable) effect.	Positive Adverse
Magnitude	Size or severity of the residual effect relative to the existing conditions of each Wildlife and Wildlife Habitat subcomponent. Generally measured in terms of the proportion of each subcomponent indicator affected within the RAA. The magnitude of the effect on habitat for wildlife was assessed using the thresholds defined in **Table 4.4-2.**	• Low • Moderate • High
Geographic extent	Geographic area over which the residual effect to each subcomponent is expected to occur. Direct effects to wildlife (e.g., habitat loss) occur primarily at the site level at specific locations within the Project footprint. Indirect effects to wildlife (i.e., sensory disturbance) occur primarily at the local level (sometimes at the regional level). Effects on wildlife at the population level occur at the Regional and Territorial levels.	• Site (specific location within Project footprint) • Project footprint • Local (limited to footprint and adjacent habitat) • Regional (RAA) • Territorial (beyond RAA)
Timing	Occurrence of the residual effect with respect to a temporal attribute important to each Wildlife and Wildlife Habitat subcomponent (e.g., season with highest interaction)	• Seasonal (species-specific seasons) • Year-round
Frequency	How often the residual effect is expected to occur, taking into account temporal characteristics of Project activities relative to interaction with each Wildlife and Wildlife Habitat subcomponent.	• Infrequent • Frequent • Continuous
Duration	Length of time over which the residual effect is expected to persist, taking into account temporal characteristics specific to each subcomponent and the Project effects that may change over time depending on Project phases. Definitions of "short-term" and "long-term" vary depending on the subcomponent.	• Short-term (seasonal) • Long-term (life span of subcomponent) • Permanent
Reversibility	Degree to which the residual effect to each wildlife subcomponent can be reversed once the causal factors cease. Irreversible effects are considered to be permanent.	• Fully reversible • Partially reversible • Irreversible
Likelihood	Likelihood that the residual effect will occur, taking into account how probable it is that an effect will be caused by the Project or that a specific mitigation will be successful.	• Likely • Unlikely
Context	The extent to which each Wildlife and Wildlife Habitat subcomponent has been affected by past and present processes and conditions, its potential sensitivity to the Project-related residual effect, and its ability to recover from that effect (i.e., resilience). e.g.: High: a Wildlife subcomponent has a natural resilience and can respond or adapt to the disturbance before an effect can be detected within the population. Low: a Wildlife subcomponent has low resilience and will not easily adapt to the disturbance, and an effect can be readily detected within the population.	• High • Moderate • Low

Thresholds were used to characterize the magnitude of habitat loss and reduction in habitat effectiveness. For most bird and mammal species, evidence suggests that with less than 10–30% of remaining suitable habitat, habitat fragmentation compounds the effects of habitat loss on population size (Andren 1994; Swift and Hannon 2010). Using a conservative approach that considers more than the threshold of population persistence, and to reflect the inherent variability in in various species' tolerance of habitat loss, a difference of greater than 15% from baseline to maximum disturbance (i.e., 85% habitat remaining unaltered) is considered a high magnitude effect (**Table 4.4-2**). This threshold reflects a conservative approach to the assessment and was applied to all species where habitat suitability modeling was performed. Species-specific thresholds were identified for Grizzly Bear based on available literature and provided additional support for the magnitude determinations.

There are no known or definitive habitat loss or disturbance thresholds specific to Caribou. Such thresholds are generally established to maintain species or population persistence and diversity; however, use and determination of appropriate thresholds is debated (Swift and Hannon 2010). Previous environmental assessments for other northern mining projects have used criteria for habitat disturbance ranging from 10 to 40% in seasonal range as a measure of the significance of a Project's effect on habitat (e.g., Meadowbank — Cumberland Resources Ltd. 2005; High Lake — Wolfden Resources Inc. 2006; Gacho Kué — De Beers Canada Inc. 2010). Considering the habitat disturbance threshold applied to the Project's other wildlife subcomponents, thresholds used for other projects, and due to the uncertainty in Fortymile and Klaza Caribou habitat usage within the FC-RAA, the habitat disturbance thresholds applied to Caribou were: low magnitude = 0–5%; moderate magnitude = 5–10%; and high magnitude = >10% (**Table 4.4-2**).

Table 4.4-2 Habitat Disturbance Thresholds for Wildlife

Magnitude of Effect	Caribou	All Other Species
	Habitat Disturbance Threshold	Habitat Disturbance Threshold
Low	0 – 5%	0 – 10%
Moderate	5 – 10%	10 – 15%
High	>10%	>15%

4.4.2 SIGNIFICANCE DEFINITION

Significance of the Project's effect(s) on Wildlife and Wildlife Habitat is determined based on consideration of one or more of the following sources of information (Canter 1999):

- Guidelines or standards outlined in laws, regulations, policies, etc.
- Pre-defined thresholds
- Setting (e.g., is the Project in a protected habitat or sensitive zone, or land-use zone)

- The intensity of the effect (e.g., anticipated percentage change and whether the change is within normal variability), and
- Public / stakeholder concerns.

When determining significance, each of the ratings used to characterize the residual effect are considered to inform the final decision. The level of each residual effect is rated as "Significant" or "Not Significant" as follows.

Significant Residual effects determined to be "Significant" are those that would result in a measurable adverse effect that would pose a risk to the long-term persistence and viability of Wildlife and Wildlife subcomponents/indicators at the regional level (i.e., RAA). The level at which the combination of effects characteristics would represent a significant adverse effect varies depending on species and is described under the section for each subcomponent. All residual effects, regardless of significance, are carried forward to the cumulative effects assessment.

Not Significant Residual effects determined to be "Not Significant" are those that are greater than "negligible" but that do not meet the definition of "Significant". Residual effects determined to be "Not Significant" are still carried forward to the cumulative effects assessment.

Presently no thresholds or standards currently exist for the Wildlife and Wildlife Habitat subcomponent indicators. The significance of changes is estimated using professional opinion based on the biology of each of the indicators, experience with similar projects, and relevant technical literature and TK where noted.

The level of confidence in the significance determination is rated as low, moderate, or high as follows:

Low A low level of confidence is assigned to the effects predictions with little or no empirical site-specific data and little to no published information or examples from similar assessments or Project effects monitoring programs.

Moderate A moderate level of confidence is assigned to the effects predictions that are based on published literature and empirical site-specific data from other projects of a similar scale with similar indicators; however, baseline data may not be entirely sufficient for the Project.

High A high level of confidence is assigned to the effects predictions that have direct, site-specific quantitative data to support the assessment, either from the Project or existing similar projects with similar Wildlife indicators. Baseline data are also considered sufficient for the Project.

The following subsections review how the potential effects (**Section 4.2**) apply to each subcomponent and describe specifically how the mitigation measures (**Section 4.3**) work to minimize or eliminate those potential effects. This is followed by presentation of residual effects that remain after mitigation measures are applied, and determination of significance of the residual effects for each subcomponent.

4.4.3 FORTYMILE CARIBOU SUBCOMPONENT

4.4.3.1 Potential Project-related Effects on Fortymile Caribou

Potential Project-related effects on Fortymile Caribou include habitat loss from the Project footprint, reduced habitat effectiveness from sensory disturbances, increased mortality risk from collisions with vehicles on the NAR and increased unmanaged harvester access, and alteration to movement in response to Project infrastructure. Effects on Fortymile Caribou are assessed in relation to the winter season (October – April), which is when Fortymile Caribou are expected to occur in abundance within the FC-RAA. The potential for the NAR to facilitate predation on Fortymile Caribou is discussed as a Subject of Note in **Section 4.5**.

4.4.3.2 Mitigation Measures for Fortymile Caribou

Mitigation measures applicable to the potential Project-related effects on Wildlife and Wildlife Habitat are summarized above in **Table 4.3-1**. The mitigation measures that will be used to minimize Project effects on Fortymile Caribou include the following: Project Design, Project Personnel Wildlife Awareness Orientation, Minimize Habitat Disturbance, Reduce Human-Wildlife Encounter Risks, Wildlife Protection Protocols, Manage Traffic, Reduce Barriers to Movement, Manage Aircraft Operations, and Prevent Wildlife Entrapment — summaries of which are provided in **Section 4.3** and details in the WPP (**Appendix 31-F**).

Mitigation specific to reducing the effects of mortality risk and alteration to movement focuses on the management of Project activities during winter when Fortymile Caribou are expected in the Project vicinity. During fall migration (typically October through November) and spring migration (February to April) periods, the Project could interact with large groups of Caribou as they move through the area. Phased mitigation measures, triggered by the presence of approaching or increasing numbers of Caribou, will be implemented (refer to the WPP, **Appendix 31-F**, for details). The phased approach involves a gradual decrease in Project activities and heightened awareness and communications for Project personnel as Caribou approach the Mine Site or the NAR.

Mitigation measures will be effective at reducing, but not eliminating, residual effects of habitat loss, reduced habitat effectiveness, mortality risk, and alteration to movement.

Mortality risk may be direct (via collisions with vehicles or interactions with Mine Site infrastructure), or indirect via improved harvester access into hunting areas.

The risk of wildlife mortality resulting from interactions with Mine Site infrastructure was considered during Project design. To limit the potential for wildlife mortality, several design elements and mitigation measures were developed including the use of wildlife-safe fencing to prevent access to the events ponds during Operation, measures to prevent ingress of caribou into open pits, and the maintenance of access roads into the open pits at Closure to avoid the potential for entrapment within the pits. With the implementation of these mitigation measures, as well as other Caribou mitigation (e.g., phased mitigation during migration) mortality risk as a result of interactions with Mine Site infrastructure is expected to be low and is not considered as a residual effect for Fortymile Caribou.

Indirect mortality risk as a result of improved harvester access is currently low. Licensed caribou harvest is closed in all GMSs that overlap the Project footprint and TH has a voluntary no-harvest program in place. With the expanding herd range and increasing herd size, Yukon and TH governments are considering re-opening Yukon harvest for Fortymile Caribou (M. Suitor, Pers. Comm. 2014-2016; K. Meister, pers. comm. 2016). However, exactly when Yukon harvest may reopen is currently unknown. Should the harvest be reopened during the Project lifetime, the Project is not expected to substantially increase harvester access. Access control at the Stewart and Yukon rivers crossings may be implemented, preventing unauthorized access south of the Stewart River. The NAR will also be closed for portions of the hunting season (i.e., up to 42 days in November to December for the fall freeze-up suspension period, and up to 28 days in April to May for the spring thaw suspension period). Based on the current low probability of indirect mortality risk from hunting, indirect mortality risk due to improved harvester access is not considered a residual effect on Fortymile Caribou.

4.4.3.3 Residual Effects and Significance of Residual Effects on Fortymile Caribou

Project-related residual effects were assessed based on potential interactions (**Table 4.1-2**). Residual effects include: habitat loss due to the Project footprint, reduced habitat effectiveness due to sensory disturbance, mortality risk (from vehicle collisions), and alteration of movement. Background information describing the potential residual effects is followed by an assessment of the residual effects and significance.

Background Information

Habitat Loss and Reduced Habitat Effectiveness — Project effects on Fortymile Caribou habitat can result from direct habitat loss from the Project footprint, or indirectly from Project activities or infrastructure that create sensory disturbances (e.g. noise, dust, movement) making adjacent habitat less effective. While direct habitat loss is readily quantified (e.g., footprint area), reduced habitat effectiveness is not as quantifiable. Reduced habitat use by Caribou in response to disturbances has been documented at distances ranging from 250 metres to 30 km from resource development footprints and other human activities (Dyer et al. 2001, Polfus et al. 2011, Boulanger et al. 2012, Johnson and Russell 2014). This variability likely depends on caribou ecotype or subspecies (e.g., Boreal versus Woodland versus Barren-ground Caribou), terrain, vegetation types, season, and intensity or frequency of disturbance. Late winter is considered a sensitive period for Caribou as they are relying on nutrient reserves gained during the previous summer and fall to survive through to the following spring. Females are particularly susceptible to energetic demands as they are depending on those reserves for calf production in spring (Ministry of Forest, Lands and Natural Resource Operations [MFLNRO] 2014). Energetic costs associated with movement as a result of disturbance and avoidance of otherwise high quality habitat can negatively affect

Caribou by requiring them to expend additional energy and nutrient reserves foraging in less suitable habitat (Frid and Dill 2002, Seip et al. 2007).

In addition to seasonal variability, the level of activity associated with project infrastructure appears to be a predominant factor in predicting the level of response. Cumming and Hyer (1998) found that Caribou used areas near an unused logging road but avoided the area when the logging road was in use, while Murphy and Curatolo (1987) also concluded that moving stimuli (vehicles) were more disruptive to Caribou than roads themselves. Polfus et al. (2011) found that mines were avoided in summer but not at all in winter when the mines were not active. Barren-ground Porcupine Caribou had a greater response to project infrastructure based on the level of activity associated with the infrastructure. Caribou had a definitive avoidance response to the Dempster Highway (Yukon) and Dalton Highway (Alaska); however, Caribou showed much less avoidance of “low use human features”, such as wells, trails, winter roads, and seismic lines. Dust from project activities may cause Caribou to avoid areas where dust has deposited on forage, potentially reducing habitat effectiveness near these dust sources. Road dust has been found to deposit on vegetation up to 70 m away from road sources (Walker and Everett 1987). Dust deposition up to 14 km away from the Diavik-Ekati diamond mine complex in the Arctic was the suspected mechanism of reduced Caribou occurrence neat that mine complex (Boulanger et al. 2012).

Mortality Risk — Mortality risk for Fortymile Caribou may increase directly via collisions with vehicles on the NAR and Mine Site roads or interactions with other Mine Site infrastructure (e.g., entanglement in fencing; entrapment in open pits or ponds). Mortality risk will be greatest in areas known to be used by Fortymile Caribou within their winter range (based on late winter surveys, satellite collar data, and snow track data: **Figure 2-5**, **2-7** and **2-8** in the Wildlife Baseline Report, **Appendix 16-A**; remote camera studies on the NAR and other roads in the area: Wildlife Field Program Report, **Appendix 16-D**).

Main roads, such as highways, are known to be direct sources of mortality for Caribou due to vehicle collisions (O’Donoghue 1996; Florkiewicz et al. 2007). Mining roads are also known to be direct sources of Caribou mortality. During seven years of road operation at the Agnico Eagle Mine, 12 Caribou mortalities were reported (Agnico Eagle Mine Limited 2009, 2010, 2012, 2013). In comparison, other mining projects (e.g., Diavik, Ekati, Baffinland, Red Dog, and Snap Lake) have reported no Caribou-vehicle collisions; however, some instances of having to deter Caribou from airstrips have occurred. Collisions between Caribou and vehicles are typically higher at night or in low light conditions, and may increase during Caribou migration periods (September to December; February to April; TIRF 2012).

Alteration to Movement — Based on collar data, most occurrences of FMCH occur in the FC-RAA during winter (October to April). The physical presence of the Project footprint, as well as associated levels of activity and/or disturbance, could alter the movement of the FMCH during winter by acting as partial barriers or filters to movement by changing the timing and direction of movement (Cameron and Whitten 1980, Curatolo and Murphy 1986, Mahoney and Schaefer 2002, Wilson et al. 2016). Alteration to movement can be detrimental to long-distance migrating Caribou that move between seasonally-important ranges (Berger 2004; Bolger et al. 2008), such as the FMCH. The potential effect of alteration to movement would occur primarily during the Construction, Operation, and Reclamation and Closure phases when Project activities are occurring.

The response of Caribou to linear features is dependent on several factors including road use, traffic volumes, embankment characteristics, and snow clearing practices (Dyer et al. 2002; Wilson et al. 2016). Woodland Caribou in Alberta crossed roads (with traffic) during late winter six times less frequently than simulated roads (Dyer et al. 2002). Wilson et al. (2016) detected a response by Barren-ground Caribou in Alaska during fall migration at distances up to 15 km from a 12 m wide mining road with traffic volumes of 98 haul trucks per day, 24 hours a day. While the majority of the migrating Caribou did not respond to the mining road, approximately 30% of the Caribou studied were delayed (i.e., approximately 30 days longer) in crossing the road. Panzacchi et al. (2013) found a similar result with reindeer being delayed by approximately five days while looking for an optimal area to cross a high use road (e.g., 500 vehicles/day) to get to important calving grounds on the other side. A study at the Ekati diamond mine in the NWT found that 57% of Caribou tracks deflected from the mine road during spring migration (April and May), and that snow bank heights >0.5 m were the most important deflection factor for Caribou movement, while snow-free roads did not alter movement (Rescan Environmental Services Ltd. 2012). There is also evidence that Caribou within the same herd may respond differently to project infrastructure and activities, which suggests that the potential adverse effects to Caribou might not be constant and could vary seasonally and at the individual level (Wilson et al. 2016).

Caribou may habituate to human activity and infrastructure over time (Haskell et al. 2006; Hesselink and Baggio 2013); however, the degree of habituation is dependent on several factors such as infrastructure/activity type and frequency, surrounding habitat, sex and age of Caribou, season of use, and predator-prey dynamics (Wolfe et al. 2000; Hesselink and Baggio 2013). Given that a proportion of the FMCH has migrated across existing portions of the NAR footprint between 2014 and 2016, it is possible that Fortymile Caribou may habituate to human activity and Project-related infrastructure over time (Wildlife Baseline Report, **Appendix 16-A**).

Habitat Loss and Reduced Habitat Effectiveness

Habitat loss from the Project footprint is assessed as complete habitat loss which is a conservative approach to the assessment since much of the NAR consists of existing road sections (140 km of 177 km) that are already disturbed. Reduced habitat effectiveness due to sensory disturbances (e.g., noise, dust emissions, movement etc.) is assessed using the ZOI approach (**Section 2.0**). The ZOI estimated for Fortymile Caribou is based on a literature review (described below) and summarized in **Table 4.4-3**, and is based on the documented distributional response of Caribou to various types of disturbances, including disturbance similar to the Coffee Project.

Vistnes and Nellemann (2008) provided a summary of 85 studies looking at Caribou avoidance. In most studies, Caribou densities decreased by 50–95% within 5 km of human disturbance (Vistnes and Nellemann 2008). Nelleman and Cameron (1996) observed a 52% reduction in Caribou <4 km from roads and oil production facilities in Alaska, and a subsequent 43% increase in Caribou usage outside of that boundary. Joly et al. (2006) determined that total Caribou density is reduced by at least 24% in all areas within 0–4 km of a road, and upwards of 84% between 2 and 4 km of a road in areas where pre-construction densities of Caribou were highest. In a similar region as the Project, Polfus et al. (2011) found that Woodland Caribou avoided low-use roads (gravel/dirt roads, excluding ATV trails) by 1 km and high use roads (paved or plowed during winter) by 2 km near Atlin, BC. Weir et al. (2007) observed that Woodland Caribou reduced habitat use in areas within 0–4 km of a Mine Site in Newfoundland. During late winter, they detected up to 50.5% fewer collared Caribou observations from 0–4 km, of the mine during the construction and operation phases compared with distribution prior to disturbance. In Polfus et al. (2011), Caribou avoided placer mines by 250 m in summer, and a ZOI was not detected at all near the mine footprints when mining activity ceased in the winter months. Boulanger et al (2012) studied Barren-ground Caribou responses to a large diamond mine complex (Ekati Mine and Diavik Mine, ~40 km²) in the Arctic. Although a large ZOI was detected when both mines were operational (see below for discussion), at earlier phases of mine development a much smaller 4 km ZOI was detected when only the ~30 km² Ekati Mine was constructed, and in some years no ZOI was detected.

Although the majority of ZOIs detected appear to be within 4 km from a disturbance, relatively large ZOIs (e.g. 14 km) have been detected in some studies, which appear to be influenced by the level of disturbance, herd size, and environmental/topographic considerations (Boulanger et al. 2012, Johnson and Russell 2014). Boulanger et al. (2012) detected a 14 km ZOI for the large Ekati Mine and Diavik Mine (~40 km²) in the Arctic, correlated with a modeled dust deposition concentration of 23 kg/ha/year. The dispersion of dust is likely much more prevalent in open Arctic tundra environments where winds are high and barriers to dust dispersal are limited (e.g., low terrain relief and no tall vegetation), potentially resulting in higher levels of dust deposition on forage vegetation compared to forested environments like the Project. Johnson and Russell (2014) detected an 11 km ZOI around winter roads, seismic lines, trails and other “low use human features” by the Barren-ground Porcupine herd in Yukon and Northeast Alaska. Large groups of Caribou have been found to have heightened responses to disturbances than smaller groups, as evidenced by greater movement rates and low success rates of large groups crossing linear features (Murphy and Curatolo 1987) and observations of smaller Caribou groups in closer proximity to disturbances than larger groups (Weir et al. 2007).

The NAR will likely be similar to the low-use road ZOI observed by Polfus et al. (2011) due to habitat similarities to the FC-RAA and anticipated levels of road traffic. The NAR will be gravel and have low Project-related traffic volume (i.e., maximum eight trucks per day during Operation Phase) and will be periodically closed during fall freeze-up and spring thaw once operational, further limiting the level of activity on the road. Furthermore, portions of the NAR already exist and exhibit some level of disturbance. It is therefore likely that Fortymile Caribou have already been exposed to sensory disturbance effects of the road. The disturbance from the Mine Site is likely larger than the 2 km² mine where caribou response was studied by Weir et al. 2007, yet much smaller than the ~40 km² diamond mines studied by Boulanger et al. (2012). In the Boulanger et al. (2012) study, a 4 km ZOI was detected when only the ~30 km² Ekati Mine was constructed.

In an effort to take a conservative approach to assessing Project-related effects on Caribou habitat, the ZOI developed for Fortymile Caribou extends to 4 km from the Mine Site footprint and 2 km from the NAR footprint. The extent to which habitat effectiveness is reduced decreases with distance from the Project footprint, and due to the larger size of the Mine Site ZOI, this reduced habitat effectiveness has been accounted for within this 4 km ZOI (**Table 4.4-4**, **Figure 4.4-1**). The Mine Site ZOI contains the highest modelled noise and dust levels predicted for the Project. Dust was not modeled for the NAR; however, the ability of dust to disperse is expected to be greater at the Mine Site than the NAR due to its higher elevation and more open landscape setting. Major sources of fugitive dust at the Mine Site during construction and operation will include the open pits, stockpiles, WRSFs, haul roads, and the HLF, whereas the only Project-related source of dust along the NAR during these phases will be road dust from vehicle traffic.

Table 4.4-3 Summary of ZOI Distances Documented in Multiple Caribou Studies

ZOI detected	Context	Magnitude of Effect [1]	References
None detected	Operating Ekati Diamond Mine and construction phase of Diavik Diamond Mine in open Arctic tundra habitat. ZOI analysis based on collared Caribou and predicted habitat use modeling	NA	Boulanger et al. 2012
250 m	Woodland Caribou response to inactive/low level activity at mine in winter	Not identified in study	Polfus et al. 2011
1 km	Woodland Caribou response to low use road	Not identified in study	Polfus et al. 2011
250 m and 1 km	Woodland Caribou response to seismic lines and oil and gas wells, respectively	48–22%	Dyer et al. 2001
1–5 km	Hypothesized ZOI for major disturbances based on previous approaches for similar species in the Arctic and literature review (not based on Caribou distribution data or modelling)	95%–50%	Johnson et al 2005
1–4 km	Reduced density along oil field access roads during calving	86%–30%	Cameron et al. 1992, Reed et al. 1992
2 km	Woodland Caribou response to high-use roads	Not identified in study	Polfus et al. 2011
4 km	Woodland Caribou liner development and Mine Site construction and operation	41%–51%	Weir et al. 2007
2–4 km	Avoidance of roads and other infrastructure by calving Barren-ground Caribou.	84%–24%	Joly et al. 2006

ZOI detected	Context	Magnitude of Effect [1]	References
4 km	Reduction in Caribou near roads and oil production facilities in Alaska	52%	Nelleman and Cameron 1996
4 km	Arctic tundra environment and reduced Caribou occurrence suspected due to dust on vegetation. ZOI varied substantially between Project phases. 4 km ZOI detected when Ekati Mine was in construction and operations phases	83%	Boulanger et al. 2012
6–11 km	Variable ZOI for avoidance based on time since development of low human disturbance infrastructure (i.e. winter roads, seismic lines)	Not identified in study	Johnson and Russell 2014
14 km	Arctic tundra environment and reduced Caribou occurrence suspected due to dust on vegetation. ZOI varied substantially between Project phases. 14 km ZOI was detected when full mine complex (Ekati and Diavik Mines) was operational (~ 40 km^2). The 14 km ZOI was correlated with a modeled dust deposition rate of 23 kg/ha/year.	76%	Boulanger et al. 2012

1 The magnitude of the effect identified by the literature review either relates to the reduction in habitat effectiveness or quality calculated by the authors, or the proportion or modeled probability of Caribou responding to disturbance within the identified ZOI.

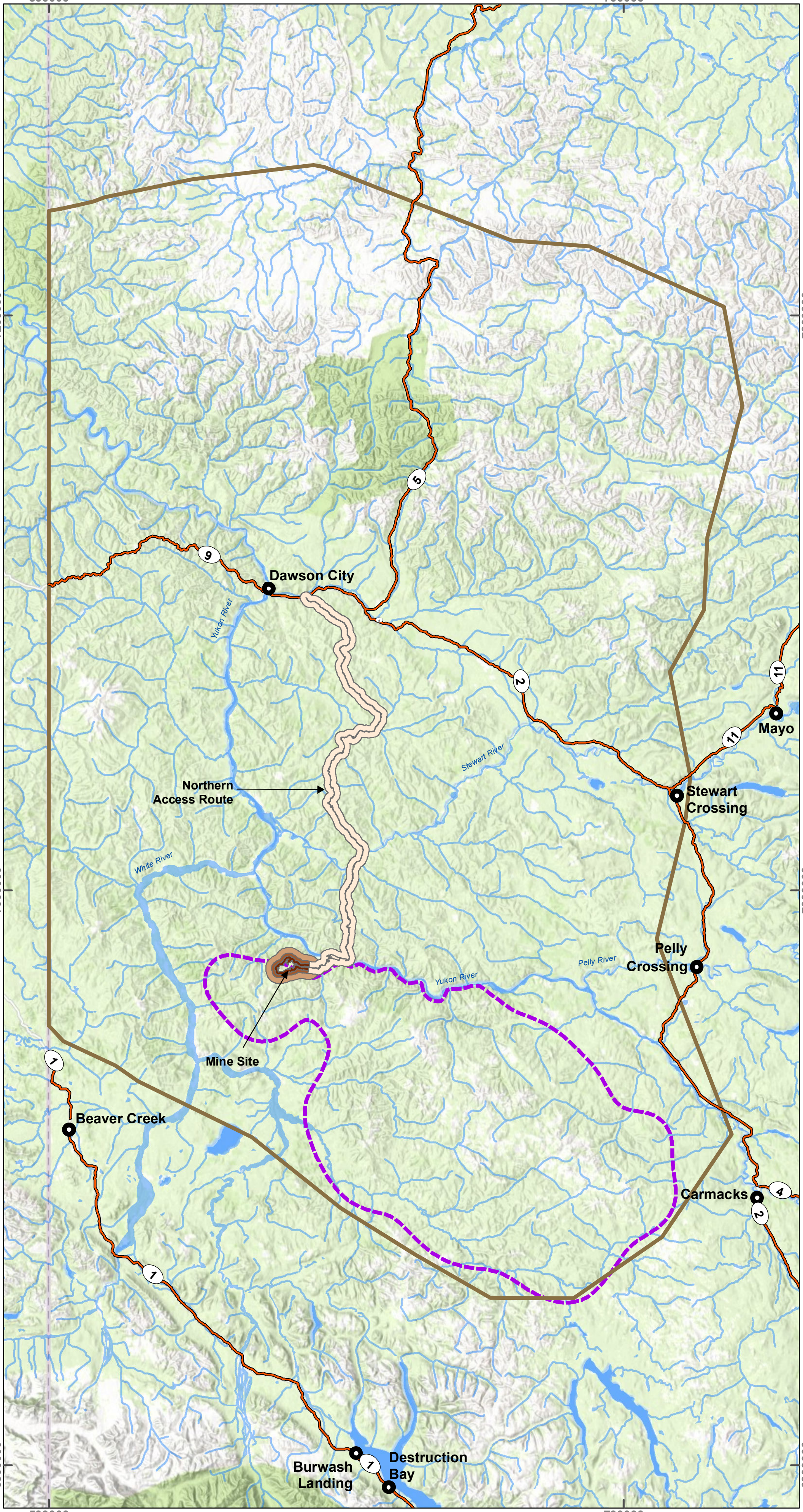
Table 4.4-4 Reduced Habitat Effectiveness within the Project Footprint and Zone of Influence (ZOI) on Fortymile Caribou

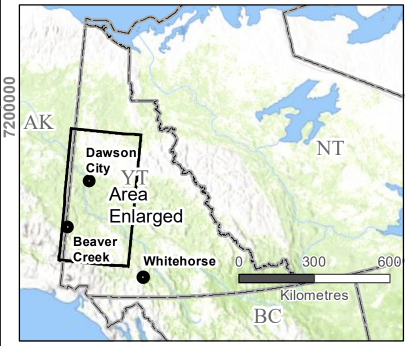
Residual Effects	Footprint/Proximity to Footprint	Reduced Habitat Effect[1]	Comment / Rationale
Direct Habitat Loss	NAR and Mine Site footprint	100%	Area physically occupied by the NAR and Mine Site. Includes barge landings, new NAR footprint, and portions of the existing road that will be upgraded.
Reduced Habitat Effectiveness from Mine Site	< 1km	80%	Includes sensory disturbance related to noise and highest fugitive dust levels
	2 km	40%	Accounts for majority of studies that observe a ZOI (**Table 4.4-3**) and has been documented as the ZOI for mines in similar habitat as the Project (Polfus et al. 2011) and similar sized mining operations in arctic environments (Boulanger et al. 2012)
	4 km	20%	
Reduced Habitat Effectiveness from NAR	2 km	50%	Similar ZOIs documented for low use and high use roads in similar environment (Polfus et al. (2011) and other areas (Cameron et al. 1992, Joly et al. 2006). Due to planned low use of NAR and temporary road closures and existing disturbance associated with the road, this ZOI is considered to be conservative

1 Reduced habitat effect on habitat related to 1) direct habitat loss from the Project footprint (100% habitat loss) or 2) degree of reduction in habitat effectiveness due to sensory disturbance, decreasing with distance from the Project footprint

COFFEE GOLD MINE

The Coffee Project's Potential Zone of Influence





Legend

- City/Town
- Highway
- Fortymile Caribou Regional Assessment Area (FC-RAA)
- Klaza Caribou Regional Assessment Area (KC-RAA)

Distance from Project Footprint (reduced habitat effectiveness)

- Mine Site: 0 - 1 km (80%)
- Mine Site: 1 - 2 km (40%)
- Mine Site: 2 - 4 km (20%)
- Northern Access Route: 0 - 2 km (50%)

Notes

1. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

1. Sources: Esri, HERE, DeLorme, increment P Corp., NPS, NRCan, Ordnance Survey, © OpenStreetMap contributors, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community
2. Fortymile caribou herd study area adapted by data provided by Yukon Government (further developed by EDI Environmental Dynamics Inc.
3. Zones of influence created by EDI are based on distance buffers applied to the project footprint.
4. Project access and infrastructure provided by Goldcorp Inc. (2017).

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Figure 4.4-1	Date: Mar 23, 2017	Drawn by: MP	Reviewed: AM/MS

GOLDCORP

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Project effects on habitat are assessed within the spatial boundary of the FMCH winter range in Yukon (FC-RAA) and effects will be realized during the Project's Construction and continue through the Reclamation and Closure phases. Potential project effects on Fortymile Caribou habitat were estimated by multiplying the RSF-weighted habitat area by the relevant effect coefficient. For example, 10 ha with an RSF score of 0.75 would have a weighted habitat area of 7.5 ha. If that occurred within the 2 km ZOI of the NAR, the resulting decrease in habitat effectiveness would be 0.5 x 7.5 = 3.75 ha. Direct habitat loss associated with the Project footprint will include 23.4 km² (0.05%) of habitat within the FC-RAA. Sensory disturbance within the ZOI reduces habitat effectiveness in an additional 302.2 km², or 0.66% of the habitat within the FC-RAA. The total habitat altered within the FC-RAA due to direct habitat loss and reduced habitat effectiveness is 0.7% of the habitat in the FC-RAA (**Table 4.4-5**).

Table 4.4-5 Area of Habitat Loss and Reduced Habitat Effectiveness for Fortymile Caribou

Residual Effects	Project Footprint or Distance from Footprint	Effect Multiplier[1]	Habitat Altered (km²)	% of FC-RAA
Direct Habitat Loss	NAR and Mine Site	-	23.4	0.05
Reduced Habitat Effectiveness (within ZOI) – NAR	2 km	0.5	525.7*0.5=262.8	0.57
Reduced Habitat Effectiveness (within ZOI) – Mine Site	<1 km	0.8	23.6*0.8=18.9	0.04
	2 km	0.4	23.3*0.6=9.3	0.02
	4 km	0.2	57.0*0.2=11.4	0.03
Total Habitat Altered			**325.8**	**0.71%**

1 The habitat effect multiplier is based on the level of reduced habitat effectiveness. A habitat effect multiplier of 0.5 equates to 50% reduced habitat effectiveness.

Note: The FC-RAA is 77,532 km².

After implementation of the proposed mitigation measures related to minimizing the Project footprint and reducing effects of sensory disturbance, the residual effect of habitat loss and reduced habitat effectiveness is only 0.7% of the FC-RAA which is considered a low magnitude effect (**Table 4.4-1**). Fortymile Caribou primarily use the FC-RAA during winter, limiting the timing of habitat effects to winter habitat. Habitat effects would be long-term and are considered fully reversible after mine closure and reclamation.

The context for the effects on Fortymile Caribou habitat is considered high. Although the herd has tolerated habitat disturbance within their range, such as the Top of the World and Dempster Highways in Yukon, results of RSF analysis indicate that there is some degree of avoidance of roads as road density increases. Satellite collar data indicate that Caribou migrate across these highways, which have not prevented the FMCH from expanding their range in Yukon, suggesting the herd is resilient to some amount of habitat disturbance. Furthermore, the FMCH has shown continuous growth since the population low in the 1970s, the herd is not a listed species, and there is currently no hunting of the FMCH, reducing population stresses. Based on these considerations, and summarized in **Table 4.4-6**, the residual effects of habitat loss and reduced habitat effectiveness are considered not significant and are not expected to affect the viability of the FMCH. The level of confidence in this significance determination is moderate based on limited aerial survey and satellite collar data, uncertainty of habitat use and distribution in the FC-RAA, and the variability of Caribou responses to human activities.

Table 4.4-6 Summary of Residual Effect Characteristics Ratings for Fortymile Caribou – Habitat Loss and Reduced Habitat Effectiveness

Residual Effect Characteristic	Definition	Rating
Direction	Adverse	Habitat loss and reduced habitat effectiveness are adverse effects.
Magnitude	Low	Considered low based on proportion of habitat loss (0.05%) and reduced habitat effectiveness (0.66%) in the RAA and is unlikely to pose a risk to the long-term persistence and viability of the entire FMCH at the regional level.
Geographic Extent	Local	Residual effects will be limited to the Project footprint and ZOI.
Timing	Winter (October – April)	The Project is located within the known winter range for the FMCH. Although there is some potential for effects to occur in later summer when a few collared individuals were identified in the FC-RAA (**Section 3.3.1.1**), the majority of interactions would be in the winter season (October – April).
Frequency	Continuous	Habitat would be affected over the life of the Project. Although the level of activity would change throughout the Project, residual effects would be continuous.
Duration	Long-term	Occurs over the life of the Project (i.e., >20 years)
Reversibility	Fully Reversible	Fully reversible after mine closure and site reclamation. The Mine Site, barge landings and portions of the NAR constructed for the Project (i.e. 37 km) will be decommissioned at closure.
Likelihood	Likely	Fortymile Caribou herd are known to use habitat in the Project footprint and ZOI

Mortality Risk

Increased mortality risk due to collisions with vehicles was assessed qualitatively, based on an assessment of Fortymile Caribou interaction patterns with the Project footprint using data from late winter ungulate surveys, satellite collars, and the remote camera studies (Wildlife Baseline Report, **Appendix 16-A**; Wildlife Field Program Report, **Appendix 16-D**). The magnitude of the effect was determined as a value of potential mortalities relative to the population of FMCH, which was last estimated at 51,675 Caribou in 2010 (Boertje et al. 2012).

Baseline data indicate that to date, Fortymile Caribou are only found near the Project during winter (October to April) and that the number of Fortymile Caribou can vary dramatically from year to year (Wildlife Baseline Report, **Appendix 16-A**). Use of the FC-RAA near the Project in any given year could range from no Caribou, to small numbers of Caribou in isolated parts of the FC-RAA, to thousands of Caribou moving through or wintering across large portions of the FC-RAA or near the Project. Therefore, the potential for Caribou-vehicle collisions is expected to vary greatly by year, depending on the presence of Caribou, but will be limited to the winter season. Baseline studies also indicate that when Fortymile Caribou are present in the FC-RAA, they can be found in a wide variety of habitat types ranging from valley bottom and low elevation forests, to alpine and subalpine habitats; however, the majority of Caribou observed during baseline surveys were located in higher elevation habitats, suggesting that the potential for Caribou-vehicle collisions may be higher in these habitat types.

Overall, the probability of Caribou-vehicle collisions is low. Project-related traffic will be approximately eight trucks per day. The speed limit will be 50 km/hr. Reduced speeds are a proven method of reducing the potential for wildlife-vehicle collisions (EDI Environmental Dynamics Inc. 2015). Given the low traffic and low speed, there is a low probability of Project-related vehicle collisions. Year-round maintenance of the NAR will provide access to non-Project related traffic in winter, south of the Indian River; however, it is unlikely that the level of traffic along the road will substantially increase. Placer mining activities do not occur in winter, hunting primarily occurs earlier in the season, and winter recreationalists (e.g. snowmobilers) already use the NAR in winter months (**Table 8-7**, Wildlife Field Program Report, **Appendix 16-D**). Additionally, access control at the Stewart and Yukon rivers crossings may be implemented, preventing unauthorized access south of the Stewart River. To further limit the potential for Caribou-vehicle collisions, during the Fortymile Caribou migration period, phased mitigation will include heightened awareness and communications for Project personnel and an increase in mitigation along the NAR (i.e., Response Level 2: reduced speed limits will be in place; Response Level 3: all Project-related traffic along the NAR will be temporarily suspended) based on increasing proximity of large numbers of migrating Caribou. Adaptive management measures will be implemented if Project design features and mitigation measures are not effective (**Section 8.0**).

The residual effect of increased mortality risk to Fortymile Caribou due to collisions with vehicles on the NAR and Mine Site roads will be adverse in direction, yet low in magnitude. Few animals will encounter road traffic where collisions are unavoidable due to low traffic volumes (i.e., approximately eight trucks per day) and restricted speed limits (i.e., 50 km/hr or lower) on the NAR and Mine Site roads. Furthermore non-Project related vehicles would be minimal considering placer mining activity does not occur in winter, which is the main source of current traffic on the NAR. The extent of the residual effect will be localized to the Project footprint and will occur during the winter (i.e., October to April) when Fortymile Caribou present near the Project footprint. The residual effect is expected to occur infrequently due to low traffic volume in winter and controlled speeds. The residual effect will persist over the long-term (i.e., life of the Project), but is considered fully reversible as mortality risk associated with Project-related traffic should decrease following Reclamation and Closure when the newly constructed sections of the NAR will be reclaimed. The residual effect was considered not significant and should not pose a risk to the long-term persistence and viability of the FMCH at the regional level (i.e., FC-RAA; **Table 4.4-7**). The context for the residual effect is considered high because the FMCH has shown continuous growth since the population low in the 1970s, the herd is not a listed species, and hunting of the FMCH is currently prohibited. The level of confidence in the effects predictions and significance determination is high because the road will have low traffic volumes and speed limits will be enforced, thus substantially reducing the risk of caribou-vehicle collisions.

Table 4.4-7 Summary of Residual Effect Characteristics Ratings for Fortymile Caribou – Mortality Risk

Residual Effect Characteristic	Definition	Rating
Direction	Adverse	Increased mortality risk due to collisions between individual Fortymile Caribou and Project-related vehicles on the NAR or Mine Site roads would be an adverse effect.
Magnitude	Low	A measurable effect would occur at the individual level if one or a small number of Fortymile Caribou were killed by Project-related vehicles on the NAR or Mine Site roads over multiple years. However, the effect would be unlikely to pose a risk to the long-term persistence and viability of the FMCH at the regional level (i.e., FC-RAA).
Geographic Extent	Project Footprint	The effect would occur within the Project footprint.
Timing	Winter (October – April)	The effect would occur between October and April when Fortymile Caribou are most likely to be near the Project footprint.
Frequency	Infrequent	Low traffic volumes and restricted speed limits on the NAR and Mine Site roads will limit collision risk between Fortymile Caribou and Project-related traffic. In addition, once the Construction and Operation phases begin, it is likely that direct habitat loss from the Project footprint and reduced habitat effectiveness due to sensory disturbance will limit Caribou use near the Mine Site and NAR and further limit collision risk between Fortymile Caribou and Project-related traffic.
Duration	Long-term	The effect is expected to persist over the long-term (i.e., life of the Project).
Reversibility	Fully Reversible	The effect is expected to be fully reversible after Reclamation and Closure when the newly constructed sections of the NAR and the Mine Site roads will be reclaimed.
Likelihood	Unlikely	The effect is unlikely to occur given low traffic volumes and restricted speed limits on the NAR and Mine Site roads. In addition, once the Construction and Operation phases begin, it is likely that direct habitat loss from the Project footprint and reduced habitat effectiveness due to sensory disturbance will limit Caribou use near the Mine Site and NAR.

Alteration to Movement

Alteration to movement was assessed qualitatively using satellite collar data collected from January 2014 to February 2016 and other baseline data (e.g. remote camera observations, survey data) to determine the following: (1) expected occurrence of Fortymile Caribou in the Project footprint during winter movement periods; and (2) which sections of the Project footprint might be crossed more frequently by individuals from the FMCH during winter.

Satellite collar and survey data have shown that Fortymile Caribou occurrence and movement through the FC-RAA has varied since reoccupying the portion of the FC-RAA near the Project in 2013. Large numbers of Caribou used the portion of the FC-RAA near the Project area (the baseline RSA) during the winter of

2013/2014 and again in 2015/2016, while very few Caribou were in the RSA during the winter of 2014/2015. Based on observations to date, the extent to which the herd migrates through the Project area is expected to vary from year to year (i.e. some years there may not be any Caribou in or moving through the Project footprint, some years there could be a large proportion of the herd moving through).

Baseline observations found that Fortymile Caribou generally interact with the Project between October and April. Between 2013 and 2016, the main movement into the FC-RAA and the Project area was observed in October, with smaller movements observed in November as Caribou spread out on the winter range. Boertje et al. (2012) defined six seasons for the FMCH including Autumn Migration (16 August – 30 September) and Rut/Early Winter (1 October – 30 November). The movements observed to date within the Project area are not completely consistent with the seasons defined by Boertje et al. (2012); however, based on discussions with Environment Yukon (M. Suitor, Pers. Comm. 2014-2016), the FMCH often exhibit bouts of movement from mid-August through November, which is consistent with observations in the RSA. Between December and March, Caribou within the FC-RAA near the Project are relatively sedentary on the winter range, consistent with the winter season (1 December – 31 March), although baseline studies found that some Caribou began to initiate movements back to Alaska in mid- to late February. By the end of April, Caribou have typically left the RSA. Based on these observations, potential effects to movement are expected to occur primarily between October to November, and from mid-February to April (although the timing may vary among years).

Baseline data indicates that migratory pathways used by the FMCH shift among years depending on where the Caribou are located before major movement begins, environmental conditions they encounter during migration (e.g. condition of river crossings — the fall of 2014, the FMCH were on a straight course for the Project area, hit the Yukon River and, presumably due to the river conditions, the entire herd turned north), and other factors. This is consistent with studies on migratory movements of the Porcupine Caribou Herd which have been documented using multiple migratory pathways to and from seasonal ranges and found that the herd displays large variability in directional movements (Ryder et al 2006).

While the migratory pathways can shift among years, the baseline analysis suggests that there are some general trends in the areas used during long distance migratory movements. Analysis of collar data found that long distance migratory movements were more concentrated on higher elevation terrain (and along the west side of the Yukon River), which is also consistent with local knowledge. Anecdotal reports indicate that during the fall of 2013, caribou moved into the Dawson Goldfields using ridge systems in the area. Once on top of a ridge system, caribou travelled east in large numbers (i.e., hundreds) with small groups breaking off and travelling down different ridge systems to access new areas (Kienzler and Suitor 2015). To date, collar data has documented concentrations of long-distance movements along the NAR in the higher elevation areas connecting Ruby Mountain–Reindeer Mountain–Henderson Dome (sections of the NAR along upper Maisy May, Henderson, and Eureka creeks), the higher elevation areas connecting

Mt. Stewart–Thistle Mountain–Selwyn Dome (near the Barker–Ballarat summit of the NAR), and south of the proposed Mine Site in the higher elevation areas of the Dawson Range (**Figure 2-8**, Wildlife Baseline Report, **Appendix 16-A**).

The potential for the NAR to act as a physical barrier to Caribou movement was considered during the Project design phase. Several design elements and mitigation measures were developed to limit the potential for an effect including the design of road embankments, incorporation of wildlife crossings, and management of snow banks (**Section 4.3.7**). There will be approximately eight Project-related trucks per day on the NAR, and the road will be approximately 5 m wide. Wilson et al. (2016) demonstrated that for a 12 m wide mining road with 98 haul trucks per day, 30% of their studied Caribou herd were substantially delayed (i.e., approximately 30 days longer) in crossing the road. The NAR will be closed up to 42 days in November to December for the fall freeze-up suspension period, and up to 28 days in April to May for the spring thaw suspension period. These closure periods overlap with a portion of the fall and spring migration periods for Fortymile Caribou, thereby reducing the potential for the NAR to adversely alter movement patterns for migrating Caribou. To further limit the potential for Project activities to affect Fortymile Caribou migration, phased mitigation will be implemented during the migration period with heightened awareness and communications for Project personnel and an increase in mitigation based on increasing proximity of large numbers of migrating Caribou.

Fortymile Caribou migration patterns may change among years which will influence how they interact with the Project footprint. Sections of the NAR that may be crossed more frequently by Fortymile Caribou, as indicated by late winter ungulate surveys and satellite collar data, will be monitored closely to ensure Project design features and mitigation measures are effective. Adaptive management measures will be implemented if Project design features and mitigation measures are not effective in minimizing effects on movement (**Section 8.0**). In consideration of the above factors, the potential for the NAR to adversely alter the movement patterns of the FMCH during winter will be limited.

It is unlikely that the Mine Site will present a barrier or filter to movement. The Mine Site will be a non-linear, discrete feature with visible boundaries that Fortymile Caribou can avoid. However, if Caribou decide to move through the Mine Site, they should be able to do so unimpeded because the Mine Site will not be fenced. In consideration of the above factors, the potential for the Mine Site to adversely alter the movement patterns of the FMCH during winter will be limited.

Overall, the Project is not expected to adversely affect movement patterns of the FMCH for the following reasons:

- The presence of Fortymile Caribou in proximity to the Project footprint and the FC-RAA is variable among years
- Due to fall freeze-up and spring thaw coinciding with the presence of Fortymile Caribou, and requirements for road closure during those periods, sensory disturbances from traffic may be considerably reduced

- Sections of the NAR are already existing and the FMCH has already experienced roads and traffic in other parts of their range, potentially allowing for habituation to the sensory disturbances associated with roads, and
- Mitigation, monitoring, and adaptive management measures will ensure that the potential effects of the Project on movement are minimized.

The residual effect of alteration to movement for Fortymile Caribou could be adverse in direction, low in magnitude, local in geographic extent, long-term in duration (but not permanent), and frequent in occurrence (**Table 4.4-8**). The residual effect is expected to be low in magnitude because there is little evidence to suggest that a large portion of the herd migrates through the Project footprint on a regular basis, there is no evidence to suggest that the Project footprint occupies a particularly important area for movement. Fortymile Caribou already cross existing portions of the NAR during annual migrations, and it is likely that the NAR will be closed for portions of the fall and spring migration periods. The extent of the residual effect is considered to be localized to the Project footprint and will occur during the winter (i.e., October to April) when Fortymile Caribou are most likely to be near the Project footprint. The effect is expected to occur frequently (i.e., annually during winter migration) and considered to persist over the long-term (i.e., life of the Project), but is partially reversible as the Project's influence on Caribou movement patterns should be eliminated following Reclamation and Closure. It is also possible that Fortymile Caribou may habituate to human activity and Project-related infrastructure over time. A residual effect is likely to occur given that a proportion of the FMCH migrated across the NAR footprint between 2013 and 2016, and their movement through the Project area and the region in general will likely continue through the life of the mine. The residual effect on alteration to movement is not significant, and the effect should not pose a risk to the long-term persistence and viability of the FMCH at the regional level (i.e., FC-RAA). The context for the residual effect is considered high because the FMCH has shown continuous growth since the population low in the 1970s, the herd is not a listed species, and hunting of the FMCH is either currently prohibited to licenced harvesters or subject to a voluntary harvest restriction by the TH. The FMCH has also tolerated major disturbances within its range in the past (e.g., Top of the World and Dempster highways in Yukon), and has expanded its range in Yukon. The level of confidence in the effects predictions and significance determination is moderate based on the following conditions:

- Limited late winter ungulate survey data and satellite collar data available to show long-term trends in movement patterns through the FC-RAA.
- Uncertainty about future movement patterns.
- Variable Caribou responses to human activities.

Table 4.4-8 Effect Characteristics Ratings for Fortymile Caribou – Alteration to Movement

Residual Effect Characteristic	Definition	Rating
Direction	Adverse	Alteration to movement patterns for Fortymile Caribou would be an adverse effect.
Magnitude	Low	The FMCH regularly crosses roads/highways during migration and there is little evidence to suggest that the traffic levels proposed for the NAR, or that a point source disturbance like the proposed Mine Site, would have a substantial effect on migration. Movement through the Project footprint is expected to vary by year and large numbers of caribou are not expected every year. The proposed mitigation is expected to further reduce sensory disturbances during movement periods.
Geographic Extent	Local	The effect would occur within and near the Project footprint depending if Caribou move through or around the Project footprint.
Timing	Winter (October to April)	The effect would occur between October and April when Fortymile Caribou are most likely to be near the Project footprint.
Frequency	Frequent	The effect is expected to occur frequently (i.e., annually during winter migration), but will likely vary year-to year (e.g., some years Caribou will not interact with the Project, other years they may move through the Project footprint in large numbers)..
Duration	Long-term	The effect is expected to persist over the long-term (i.e., life of the Project).
Reversibility	Partially reversible	The effect is expected to be partially reversible as the Project's influence on Caribou movement patterns should decrease following Reclamation and Closure. It is also possible that Fortymile Caribou may habituate to human activity and Project-related infrastructure over time.
Likelihood	Likely	Migratory Caribou herds exhibit unpredictable use of their winter range, so accurately predicting annual distribution, movement and occurrence near the Project in future years is not possible as there are too many variables that influence Caribou behaviour. Fortymile Caribou have the potential to occur seasonally within the ZOI during any year. Movement through the Project area in any given year could range from no Caribou, to small numbers of Caribou in isolated areas near the Project, to thousands of Caribou spread across large portions of the FC-RAA.

4.4.3.4 Summary of Project-Related Residual Effects and Significance

Project-related residual effects and proposed mitigation measures for Fortymile Caribou are summarized in **Table 4.4-9**. Residual effects on Fortymile Caribou include habitat loss and reduced habitat effectiveness, mortality risk, and alteration to movement. Residual effects on Fortymile Caribou are considered low magnitude because of the small proportion of Fortymile Caribou habitat expected to be affected by the Project (0.6% of the FC-RAA), the very low risk of Caribou-vehicle collisions, and the variability in movement pathways, that, when Caribou do cross through the Project footprint, their movement can occur unhindered. All Project-related residual effects are localized to the Project footprint and ZOI, and occur during the winter months when FMCH is present in the FC-RAA. Habitat loss will occur primarily during the Construction phase, whereas reduced habitat effectiveness, mortality risk, and alteration to movement are expected to occur during the Construction, Operation, and Reclamation and Closure phases.

The context for all residual effects is high as the FMCH has shown continuous growth since the population low in the 1970s, the herd is not a listed species, and there is currently no hunting of the FMCH, reducing population stresses on the herd. Based on these considerations, the residual effects of habitat loss, reduced habitat effectiveness, mortality risk, and alteration to movement are not significant at the regional level (i.e., FC-RAA). The confidence levels in these significance determinations are moderate based on uncertainty of future distribution of Fortymile Caribou in the FC-RAA and interaction with the Project; however, the level of confidence is considered high for the significance determination for mortality risk based on low traffic volumes, and current known movement of Fortymile Caribou near the Project footprint and effectiveness of mitigation measures to reduce Project-related mortality risk (**Section 4.3**).

Table 4.4-9 Summary of Project-Related Residual Effects on Fortymile Caribou

Residual Effects	Contributing Project Activities	Proposed Mitigation Measures	Residual Effects Characterization (see Notes for details)										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat Loss and Reduced Habitat Effectiveness	Project footprint (NAR and Mine Site) habitat lost from clearing activities and sensory disturbances associated with Project activities (e.g. noise, dust, movement)	• Project Design • Project Personnel Wildlife Awareness Orientation • Minimize Habitat Disturbance • Wildlife Protection Protocols • Manage Traffic • Manage Aircraft Operations	A	L	local	W	L	C	F	L	H	NS	M
Mortality Risk	Mortality risk from collisions with vehicles	• Project Design • Project Personnel Wildlife Awareness Orientation • Reduce Human-Wildlife Encounter Risks • Wildlife Protection Protocols • Manage Traffic • Prevent Wildlife Entrapment	A	L	PF	W	L	I	F	U	H	NS	H

Residual Effects	Contributing Project Activities	Proposed Mitigation Measures	Residual Effects Characterization (see Notes for details)										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Alteration to Movement	Project footprint could alter Caribou movement during winter	• Project Design • Project Personnel Wildlife Awareness Orientation • Manage Traffic • Reduce Barriers to Movement	A	L	local	W	L	F	F	L	H	NS	M

Residual Effects Characterization:

Direction: P = Positive, A = Adverse
Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent: Local = Project footprint or ZOI, RAA = Regional, T = Territorial
Timing: Seasonal: (W)inter or (S)ummer, Y= Year-round
Duration: S = Short Term, L = Long-term, P = Permanent
Frequency: I = Infrequent, F = Frequent, C = Continuous
Reversibility: F = Fully Reversible, P = Partially Reversible, I = Irreversible
Context: High = H, Moderate = M, L = Low
Likelihood: U = Unlikely, L = Likely
Significance: NS = Not-Significant, S = Significant
Level of Confidence: H = High, M = Moderate, L = Low

4.4.4 KLAZA CARIBOU SUBCOMPONENT

4.4.4.1 Potential Project-related Effects on Klaza Caribou

Potential effects on Klaza Caribou include direct habitat loss from the Project footprint, reduced habitat effectiveness from sensory disturbance, and mortality risk from increased harvester access. Potential Project-related effects can occur in the non-winter season when Klaza Caribou are near the Project within their annual range (the KC-RAA) and effects are expected to occur during Construction, Operation, and Reclamation and Closure phases.

Facilitated predation related to habitat changes caused by the Project development is not considered as a potential effect for Klaza Caribou. Predators (e.g., wolves) are known to use linear features to access areas to hunt Caribou during the winter months when snow depth would otherwise restrict movement. The Project footprint is located approximately 40 km outside of the KCH late winter range, and is not expected to facilitate increased predation on Klaza Caribou in the winter. Additional detail regarding predation is provided as a Subject of Note in **Section 4.5**.

4.4.4.2 Mitigation Measures for Klaza Caribou

Mitigation measures applicable to the potential Project-related effects on Wildlife and Wildlife Habitat are summarized above in **Table 4.3-1**. The mitigation measures that will be used to minimize the Project effects on Klaza Caribou include the following: Project Design, Project Personnel Wildlife Awareness Orientation, Minimize Habitat Disturbance, Reduce Human-Wildlife Encounter Risks, Wildlife Protection Protocols, Manage Aircraft Operations, Prevent Wildlife Entrapment — summaries of which are provided in **Section 4.3** and details in the WPP (**Appendix 31-F**).

A key mitigation measure specific to Klaza Caribou is included in measures to Manage Aircraft Operations. The following will be implemented to minimize reduction in habitat effectiveness due to sensory disturbance on Klaza Caribou when they may be present near the Project footprint, as detailed in the WPP (**Appendix 31-F**):

- All Project-related aircraft will maintain a minimum cruising altitude of 300 m above ground level; between May 1 and June 30 the minimum cruising altitude will be increased to 600 m above ground level when Caribou have been identified in the area (for the protection of calving Caribou)

Mitigation measures will be effective at minimizing but not eliminating Project-related effects of habitat loss and reduced habitat effectiveness for Klaza Caribou.

Direct mortality risk from Project roads is expected to be low to nil. The NAR footprint does not overlap with the KCH annual range and less than half of the Mine Site roads (11.7 of 27.3 km) overlap with the KC-RAA. Individual Caribou could become entangled in fencing (BHP Billiton Canada Inc. 2012) or fall or get trapped in Mine Site ponds or pits; however, interactions between Klaza Caribou and the Mine Site are expected to be low considering monitoring observations (Wildlife Baseline Report, **Appendix 16-A**). Reduced speed limits (50 km/h) on Project roads, mitigation to prevent wildlife entrapment, onsite wildlife monitoring, and Project personnel awareness orientation (**Section 4.3**) will mitigate mortality risk to Klaza Caribou from Mine Site roads and infrastructure. Furthermore, some level of avoidance of the Mine Site by Caribou is expected due to reduced habitat effectiveness within the ZOI. Based on these considerations, direct mortality risk due to interactions with Mine Site roads and other Mine Site infrastructure is not considered a residual effect on Klaza Caribou.

GMSs within the Project footprint that overlap with the KC-RAA are closed to Caribou hunting (Environment Yukon 2015a). Indirect mortality from hunting would be considered either First Nation harvest or illegal hunting activity. Furthermore, access control at the Stewart and Yukon river crossings will be implemented to limit public access to the southern sections of the NAR. Based on the current low probability of indirect mortality risk due to hunting and the mitigation measures described, indirect mortality risk is not considered a residual effect for Klaza Caribou.

4.4.4.3 Residual Effects and Significance of Residual Effects on Klaza Caribou

Project-related residual effects were assessed based on potential interactions (**Table 4.1-2**). Residual effects include: habitat loss due to the Project footprint and reduced habitat effectiveness due to sensory disturbance. It is expected that direct habitat loss and reduced habitat effectiveness will occur during Construction, Operation, and Reclamation and Closure phases of the Project.

Background Information

Habitat Loss and Reduced Habitat Effectiveness — A portion of the KCH annual range overlaps the Project footprint (**Figure 1.3-1**). The KCH use alpine and subalpine habitats during most of the year. Female Caribou disperse to calve in higher elevation habitat as a predatory avoidance strategy. The Caribou remain at higher elevations for the summer and fall, and into the winter. As winter progresses, Caribou descend to lower elevations at or below treeline where snow conditions (depth and hardness) are more favourable for accessing winter forage. In winter, they inhabit lichen-rich mature and old coniferous forests where snow is relatively shallow.

The Project will result in direct habitat loss within the Project footprint, and reduced habitat effectiveness from Project activities that create sensory disturbances. The NAR is not located within the KCH annual range and only a portion of the Mine Site is physically within the KCH annual range boundary. The Mine Site has the potential to interact with animals within the KCH annual range; however, not all areas are used equally, or during all seasons. Based on Project wildlife observation logs, approximately 46 Caribou have been documented using the Mine Site area since 2010 between May and September, typically as one or two individuals, with one sighting of 17 individuals. Based on the timing of these observations during summer months, the animals are assumed to belong to the KCH. Klaza Caribou are not expected to use the Project area in significant numbers during any year because the herd is concentrated in the higher elevation habitat of the Dawson Range during most of the year, and south and east of the Coffee Project during late winter.

Habitat Loss and Reduced Habitat Effectiveness

The Project effects on habitat availability are assessed within the spatial boundary of the KCH annual range (KC-RAA, **Figure 1.3-1**) and will begin at the Construction phase and continue through the Reclamation and Closure phase of the Project. Direct habitat loss associated with the Project footprint totals 6.56 km² which is the portion of the Mine Site footprint within the KCH annual range boundary. The KCH annual range is 10,819 km², therefore the Mine Site footprint represents 0.06% of the total KCH annual range (**Table 4.4-10**). The ZOI approach used for the KCH was the same as that used for the assessment of the FMCH. Methods and the rationale used to determine the ZOI are provided in detail in the Fortymile Caribou, **Section 4.4.3.3**. It was assumed that the total area within the ZOI of the Project footprint would experience a reduction in quality, with percent habitat effectiveness decreasing with proximity to the Project footprint. The ZOI extends 4 km from the Mine Site footprint in three concentric intervals of reduced habitat effectiveness (**Table 4.4-4**, **Figure 4.4-1**). Although the NAR footprint is not located within the KC-RAA, a portion of the 2 km ZOI falls within the KC-RAA. Sensory disturbance within the ZOI will result in reduced habitat effectiveness of 24.34 km² (0.22%) of the habitat within the KC-RAA. The total effect on habitat within the KC-RAA due to direct habitat loss and reduced habitat effectiveness is 0.29% of the habitat in the KC-RAA (**Table 4.4-10**).

Table 4.4-10 Area of Habitat Loss and Reduced Habitat Effectiveness for Klaza Caribou

Residual Effects	Project Footprint or Distance from Footprint	Effect Multiplier[1]	Habitat Altered (km²)	% of KC-RAA
Direct Habitat Loss	NAR and Mine Site	-	6.56	0.06
Reduced Habitat Effectiveness (within ZOI) - NAR	2 km	0.5	3.01*0.5=1.51	0.01
Reduced Habitat Effectiveness (within ZOI) – Mine Site	<1 km	0.8	12.28*0.8=9.82	0.09
	2 km	0.4	13.90*0.4=5.56	0.05
	4 km	0.2	37.23*0.2=7.45	0.07
Total Habitat Altered			**30.90**	**0.29**

1 The habitat effect multiplier is based on the level of reduced habitat effectiveness. A habitat effect multiplier of 0.5 equates to 50% reduced habitat effectiveness.

Note: The KC-RAA is 10,819 km².

The Project may alter 0.29% of the habitat in the KC-RAA, which is a low magnitude effect for Caribou habitat (<5%,**Table 4.4-2**). The residual effect of the Project on KCH habitat will be adverse in direction, low in magnitude, local in geographic extent, long-term in duration, and continuous in frequency (**Table 4.4-11**). Residual effects are considered reversible after Closure and Reclamation and the probability of occurrence is likely as KCH habitat is known to occur in the Project footprint and ZOI. The context, or ability of Klaza Caribou to adapt to the effect, is expected to be high because the disturbance occurs at the edge of their range and does not interact with limited late-winter habitat. Based on these considerations, the residual effect of habitat loss and reduced habitat effectiveness for Klaza Caribou is considered to be not significant. The level of confidence is moderate based on the known occurrence of KCH and some uncertainty about potential habitat use within the Project footprint and ZOI.

Table 4.4-11 Effect Characteristics Ratings for the Klaza Caribou – Habitat Loss and Reduced Habitat Effectiveness

Residual Effect Characteristic	Definition	Rating
Direction	Adverse	Loss of potential habitat is adverse
Magnitude	Low	Low during Construction, Operation, and Reclamation and Closure phases. In general, low amount of habitat altered to the KC-RAA.
Geographic Extent	Local	Residual effects will be limited to the ZOI
Timing	Seasonal: May to September	The Project is located within the annual range and outside the late-winter range for the KCH
Frequency	Continuous	Habitat would be affected over the life of the Project. Although the level of activity would change throughout the Project, residual effects would be continuous.
Duration	Long-term	Occurs over the life of the Project (i.e., >20 years)
Reversibility	Fully Reversible	Fully reversible after mine closure and site reclamation
Likelihood	Likely	KCH and potential effect to habitat are known to occur in the Project footprint and ZOI

4.4.4.4 Summary of Project–Related Residual Effects and Significance on Klaza Caribou

Residual effects on Klaza Caribou are habitat loss and reduced habitat effectiveness. Project-related residual effects on habitat would occur at the edge of the KCH annual range and outside of critical winter habitat during the non-winter months when Caribou are not limited by habitat availability. Habitat loss will be minimal and is expected to only occur during the Construction phase, whereas reduced habitat effectiveness is expected to occur during the Construction, Operation, and Reclamation and Closure phases. The effect of the Project on the KCH habitat is considered a low magnitude effect due to limited amount of KCH annual range that may be altered by the Project (0.29%) and is considered not significant at the scale of the KC-RAA. The context for Klaza Caribou is high considering Project effects would occur when habitat is not limited (i.e. non-winter months). The level of confidence in these predictions is moderate considering the known occurrence of KCH relative to the Project and the uncertainty in habitat use within the KC-RAA (**Table 4.4-12**).

Table 4.4-12 Summary of Project-Related Residual Effects on Klaza Caribou

Residual Effects	Contributing Project Activities	Proposed Mitigation Measures	Residual Effects Characterization (see Notes for details)										
			Direction	Magnitude	Geographic Extent	Timing	Frequency	Duration	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat Loss and Reduced Habitat Effectiveness	Project footprint (NAR and Mine Site) habitat lost from clearing activities and sensory disturbances associated with Project activities (e.g. noise, dust, movement)	• Project Design • Project Personnel Wildlife Awareness Orientation • Minimize Habitat Disturbance • Wildlife Protection Protocols • Manage Traffic • Manage Aircraft Operations	A	L	Local	L	S	C	F	L	H	NS	M

Residual Effects Characterization:

Direction: P = Positive, A = Adverse
Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent: Local = Project footprint or ZOI, RAA = Regional, T = Territorial
Timing: Seasonal: (W)inter or (S)ummer, Y= Year-round
Duration: S = Short Term, L = Long-term, P = Permanent
Frequency: I = Infrequent, F = Frequent, C = Continuous
Reversibility: F = Fully Reversible, P = Partially Reversible, I = Irreversible
Context: High = H, Moderate = M, L = Low
Likelihood: U = Unlikely, L = Likely
Significance: NS = Not-Significant, S = Significant
Level of Confidence: H = High, M = Moderate, L = Low

4.4.5 MOOSE SUBCOMPONENT

4.4.5.1 Potential Project-related Effects on Moose

Potential effects on Moose include habitat loss from the Project footprint, reduced habitat effectiveness from sensory disturbance, mortality risk from collisions with vehicles on the NAR and increased harvester access, and alteration to movement in response to Project infrastructure. Potential Project-related effects can occur year-round as Moose are year-round residents of the W-RAA. The potential for the NAR to facilitate predation on Moose is discussed as a Subject of Note in **Section 4.5**.

4.4.5.2 Mitigation Measures for Moose

Mitigation measures that will be used to reduce or eliminate the potential Project-related effects on Moose include Project Design, Project Personnel Wildlife Awareness Orientation, Minimize Habitat Disturbance, Wildlife Protection Protocols, Manage Traffic, Reduce Human-Wildlife Encounter Risks, Reduce Barriers to Movement, and Prevent Wildlife Entrapment — summaries of which are provided in **Section 4.3** and details in the WPP (**Appendix 31-F**). A summary of mitigation measures applicable to the potential Project-effects on Moose is also provided in **Table 4.3-1**. Key mitigation measures specific to Moose include the following:

- To the extent possible, construction activities will be timed to avoid Moose congregation areas during the post-rut/early winter (late October to December) and late winter Moose habitats during the late winter season (February to April).
- To minimize potential disturbance to Moose where they may congregate in areas post-rut and during the early winter (late October to December), speed limits can be reduced in those areas. The NAR will also be closed for most of the post-rut congregation period during the fall freeze-up suspension period (i.e., late October to December depending on conditions).

Following the successful implementation of these mitigation measures, three residual effects are expected to remain for Moose: (1) habitat loss due to the Project footprint; (2) reduced habitat effectiveness due to sensory disturbance; and (3) mortality risk due to collisions with vehicles and improved hunting access. Mortality risk due to interactions with other Mine Site infrastructure (e.g., entanglement in fencing; entrapment in open pits or ponds) was not carried forward in the assessment of Project-related effects for Moose. It is expected that appropriate mitigation measures and onsite monitoring will eliminate the risk of these occurrences. Alteration to movement was not carried forward in the assessment of Project-related effects because Moose do not appear to have distinct seasonal migration routes throughout the W-RAA. Instead, they appear to be widely distributed across the W-RAA throughout the year with potential habitat present around all components of the proposed Project footprint. Mitigation measures to Manage Traffic and Reduce Barriers to Movement are expected to limit potential effects to local movements of Moose.

4.4.5.3 Residual Effects and Significance of Residual Effects on Moose

Project-related residual effects were assessed based on potential interactions (**Table 4.4-12**). Project-related residual effects on Moose were considered within the context of late winter Moose habitat, Moose occurrence within the W-RAA, and Project-related activities within the W-RAA. Residual effects include: habitat loss due to the Project footprint, reduced habitat effectiveness due to sensory disturbance, and mortality risk (from vehicle collisions).

Background Information

Habitat Loss and Reduced Habitat Effectiveness — Moose are present within the W-RAA throughout the year and use a variety of habitat types depending on the season and life stage. Late winter habitat is considered a limiting factor for Moose because forage diversity and availability are reduced, and snow depth increases energetic costs. During the winter, Moose feed on the twigs of deciduous trees and shrubs including aspen, birch, and alder; however, willows are the primary winter food for Moose. Risenhoover (1989) found that willows accounted for more than 94% of the winter diet of Moose in Denali National Park and Preserve. Willows are an early successional species and are usually abundant in early seral habitats resulting from burns and human disturbances (e.g., placer mines and exploration camps).

A late winter habitat suitability index (HSI) was developed for Moose during wildlife baseline field studies (Moose Late Winter Habitat Suitability Report, **Appendix 16-C2**). Habitat suitability rated as moderate or high was considered effective habitat for Moose and included the following habitat types: shrub-dominated, wetlands, conifer with shrub, broadleaf dense, mixed-wood dense, and mixed-wood open.

Potential Project-related effects on Moose habitat include direct habitat loss due to the Project footprint and reduced habitat effectiveness in areas adjacent to the Project footprint due to sensory disturbance (i.e., noise, movement, dust). Direct habitat loss will occur during the Construction phase when the Mine Site and NAR footprints are cleared of vegetation. However, disturbed areas can be beneficial for Moose as they promote early successional vegetation growth (Beyer et al. 2013). Reduced habitat effectiveness in areas adjacent to the Project footprint will occur mainly during the Construction, Operation, and Reclamation and Closure phases due to Project-related activities at the Mine Site and Project-related traffic on the NAR. Moose have been found to avoid active roads, humans, and other mechanical stimuli at distances between 100 m and 3 km (Andersen et al. 1996; Burson III et al. 2000; Yost and Wright 2001; Jiang et al. 2009).

Mortality Risk — Main roads, such as highways, can be direct sources of mortality for Moose due to vehicle collisions. Between 2006 and 2015, a total of 20 non-harvest related Moose mortalities (e.g., vehicle collisions) were reported in the W-RAA, mainly in the vicinity of the Klondike Highway (Environment Yukon 2016d). Collisions between Moose and vehicles tend to occur at night or in low light conditions, in areas with higher moose densities and human activity levels, and in areas where roadways cross valleys or movement corridors (Child et al. 1991; Del Frate and Spraker 1991; Dussalt et al. 2006). Winter is considered the highest risk period for collisions between Moose and vehicles because snow banks along plowed roads can make it difficult for Moose to quickly move off the road to avoid traffic. Furthermore, Moose may use roads more in winter to take advantage of the reduced energy costs associated with travelling on a plowed surface.

Moose are the primary harvest species within the W-RAA for both licensed hunters and First Nations. All GMSs within the W-RAA are open to licensed hunters for bull Moose with an annual bag limit of one. Over the past ten years (i.e., 2006–2015), a total of 480 Moose were harvested by licensed hunters within the W-RAA. Mean annual harvest rates vary by subzone from 1.4 Moose/year to 8.2 Moose/year. Although subsistence harvest data are not available, it is estimated that regional First Nations harvest approximately the same number of Moose as licensed hunters (N. Ayoub, TH Fish and Wildlife Manager, Pers. Comm. 2016).

Improved access into hunting areas facilitated by roads and other linear corridors can increase mortality risk for Moose. A large portion of the W-RAA is accessible to hunters due to an abundance of roads, trails and river access, particularly within the Dawson Goldfields region. Between 5% and 10% of the total annual Moose harvest in Yukon occurs within the W-RAA, and GMSs within the Dawson Goldfields region are some of the most intensely harvested subzones in Yukon (Cooley et al. 2012). In general, harvest rates appear to be related to hunter accessibility with higher rates occurring in GMSs closer to Dawson City and within the Dawson Goldfields region where road access is better. Relatively high harvest rates also occurred within subzones accessible from the Yukon River.

Mortality risk for Moose may increase directly via collisions with vehicles or indirectly via improved hunting access. The potential effect of increased mortality risk would occur mainly during the Construction, Operation, and Reclamation and Closure phases due to Project-related activities at the Mine Site and vehicle traffic on the NAR. Following Reclamation and Closure, newly constructed portions of the NAR and Mine Site will be decommissioned and hunting access into the region surrounding the Mine Site and NAR should return to baseline levels.

Habitat Loss and Reduced Habitat Effectiveness

Habitat loss for Moose was assessed quantitatively by calculating the amount of high suitability late winter Moose habitat (i.e., habitat rated as moderate or high suitability for Moose) within the W-RAA that will be directly lost from the Project footprint or have reduced habitat effectiveness using a ZOI approach (**Section 2.0**). High suitability habitat within the W-RAA is based on the HSI developed for Moose (Moose Late Winter Habitat Suitability Report, **Appendix 16-C2**).

The width of the ZOI was based on multiple sources of information regarding the sensitivity of Moose to human activities and disturbances, including other mining projects in Yukon and British Columbia (**Table 4.4-13**). Substantially fewer (i.e., 55% less) groups of Moose were found than were expected within 300 m of a paved road through Denali National Park; however, in the author's interpretation, these results were largely influenced by the spatial pattern of preferred forage and cover (Yost and Wright 2001). Also in Denali National Park, Burson III et al. (2000) found proportionately fewer Moose within 100 m of the Denali Park road between 1972 and 1997; however, they concluded that the mechanism for decline may have been related to poorer visibility of Moose near the road due to vegetation growth. Moose in Norway fled from human stimuli such as people walking or skiing at distances of 200 to 400 m, but were less responsive to mechanical stimuli such as jet overflights (Andersen et al. 1996). Moose in northeastern China were found to avoid roads at distances up to 3 km; however, the authors concluded that influences on Moose decision-making in China are a result of many decades of disturbance from high density road networks and are likely quite different for Moose in Canada (Jiang et al. 2009). For other mining projects in Yukon and British Columbia, ZOIs ranged from 100 to 300 m.

Table 4.4-13 Summary of ZOI Distances Documented for Moose

ZOI Detected or Used	Context	References
300 m	Reduced use near road	Yost and Wright (2001)
100 m	Reduced use near road	Burson III et al. (2000)
200–400 m	Response to human and mechanical stimuli	Andersen et al. (1996)
3,000 m	Avoidance of roads	Jiang et al. (2009)
200 m	ZOI used for sensory disturbance at a Yukon mining project	Eagle Gold Project (Victoria Gold Corporation 2010)
None	ZOI used for sensory disturbance at Yukon and NWT mining projects	Ketza River Project (Ketza River Holdings 2011); Prairie Creek Project (Canada Zinc Corporation 2010), Mactung Mine Project (North American Tungsten 2009)
100 m and 250 m	ZOIs used for low and high use features at a British Columbia mining project	Prosperity Gold-Copper Project (Taseko Mines Ltd. 2009)
300 m	ZOI used for sensory disturbance at a British Columbia mining project	Seabridge Gold Inc. (Rescan Environmental Services Ltd. 2013)
300 m	ZOI used for sensory disturbance at a Yukon mining project	Casino Copper and Gold Project, (Casino Mining Corporation 2014)

In consideration of these findings and in an effort to maintain a conservative approach to Project-related effects, a 300 m ZOI was selected for the assessment of reduced habitat effectiveness on late winter Moose habitat. There is limited existing information that quantifies the magnitude of Moose avoidance of human disturbances within ZOIs, therefore a conservative approach was taken and the area of high suitability habitat (rated as high and moderate in the habitat model) with reduced habitat effectiveness were considered affected habitat with the ZOI. A 15% threshold for habitat disturbance was applied to habitat alteration for Moose within the W-RAA, the rationale for which is described in **Section 4.4.1**.

The Project could directly affect 8.14 km² of suitable late winter Moose habitat within the W-RAA, which represents 0.14% of suitable late winter habitat within the W-RAA (**Table 4.4-14**). An additional 42.89 km² of suitable late winter Moose habitat within the ZOI could experience reduced habitat effectiveness, which represents approximately 0.74% of suitable late winter habitat within the W-RAA. The combined residual effect of habitat loss and reduced habitat effectiveness could affect up to 0.88% of suitable late winter Moose habitat within the W-RAA.

Table 4.4-14 Area of Habitat Loss and Reduced Habitat Effectiveness for Moose

Residual Effects	Total Suitable Habitat in W-RAA	Habitat Loss to Footprint		Reduced Habitat Effectiveness in ZOI		Total Suitable Habitat Altered	
	km²	km²	%	km²	%	km²	%
High	3584.45	4.15	0.12	23.99	0.67	28.14	0.79
Moderate	2245.35	3.99	0.18	18.90	0.84	22.89	1.02
Total Suitable Habitat	**5829.80**	**8.14**	**0.14**	**42.89**	**0.74**	**51.03**	**0.88**

The residual effects of habitat loss and reduced habitat effectiveness on Moose are predicted to be adverse in direction, low in magnitude, local in geographic extent, long-term in duration (but reversible), and continuous in frequency (**Table 4.4-15**). The residual effects will be low in magnitude because the sum of habitat loss and reduced habitat effectiveness for effective habitat is estimated at 0.88% of the available suitable habitat within the W-RAA (**Table 4.4-14**), which is less than the 10% threshold for low magnitude effects as defined in **Section 4.4.1**. Since the residual effects of habitat loss and reduced habitat effectiveness were assessed as low magnitude, the residual effects were considered not significant and should not pose a risk to the long-term persistence and viability of the Moose population at the regional level (i.e., W-RAA). The likelihood of the residual effects occurring is likely because there will be habitat loss and reduced habitat effectiveness in areas where Moose are known to occur. The context is considered high because Moose are likely resilient to the habitat disturbance, preferring younger habitats for foraging. The level of confidence in this significance determination is moderate in consideration of the limited spatial habitat mapping available at the regional level prior to the baseline studies conducted for this Project.

Table 4.4-15 Effect Characteristics Ratings for the Moose – Habitat Loss and Reduced Habitat Effectiveness

Residual Effect Characteristic	Definition	Rating
Direction	Adverse	The loss of effective late winter habitat due to the Project footprint and sensory disturbance would be adverse.
Magnitude	Low	The estimated loss of late winter habitat due to the Project footprint and sensory disturbance is 0.14%, and an additional 0.74% reduced effectiveness of the available suitable later winter habitat in the W-RAA.
Geographic Extent	Local	Habitat loss would be limited to the Project footprint, and reduced habitat effectiveness would be limited to the ZOI.
Timing	Seasonal (winter)	The timing is seasonal because late winter habitat is considered a limiting habitat type for Moose.
Frequency	Continuous	Late winter habitat would be affected over the life of the Project (i.e., >20 years).
Duration	Long-term	Late winter habitat would be affected over the life of the Project (i.e., >20 years).
Reversibility	Fully Reversible	Fully reversible after mine closure and site reclamation.
Likelihood	Likely	Moose and effective late winter Moose habitat are known to occur within the Project footprint and ZOI.

Mortality Risk

Increased mortality risk due to collisions with vehicles was assessed qualitatively, based on an assessment of Moose interaction patterns with the Project footprint using data from late winter ungulate surveys and remote camera studies (Wildlife Baseline Report, **Appendix 16-A**; Wildlife Field Program Report, **Appendix 16-D**). Mortality risk due to improved hunting access was assessed qualitatively by considering current harvest regulations and rates and the current Moose population within the W-RAA.

Project-related vehicles will add another eight trucks/day to the existing traffic along the NAR. There is also a possibility of an increase from other non-Project users (e.g., hunters, recreational, industrial activities) primarily with the access gained during winter along the NAR due to the Project because existing portions of the NAR below the Indian River are currently not maintained during winter. However, increased non-Project traffic use of the road may not increase substantially. Placer mining does not occur during winter, hunting primarily occurs earlier in the season, and winter recreationalists (e.g., snowmobilers) already use the NAR during winter (**Table 8-7**, Wildlife Field Program Report, **Appendix 16-D**). Access gained along the NAR during the summer is not anticipated to increase traffic levels substantially along the southern sections of the proposed NAR alignment because access control at the Stewart and Yukon river crossings may be implemented, preventing unauthorized access south of the Stewart River crossing.

Although there are no Moose collision data for the existing sections of the NAR, the Klondike Highway is the closest road with Moose collision and vehicle usage statistics within the vicinity of the Project. A total of 25 vehicle collisions with Moose were recorded between 2004 and 2014 (i.e., 2.3 collisions per year) (EDI 2015). Average traffic volumes on the Klondike Highway north and south of Carmacks range from 150 to 299 vehicles per day and 300 to 599 vehicles per day, respectively (Yukon Highways and Public Works 2011). Average traffic volumes on the Klondike Highway in and around Dawson City and Whitehorse exceed 300 vehicles per day (Yukon Highways and Public Works 2011). Together, the current average traffic volumes on the NAR (~40 vehicles/day in the northern portion) and the increased traffic with the Project (eight trucks/day) are considerably less than the average daily traffic volumes on the Klondike Highway. Furthermore, the maximum speed limit along all Project roads will be 50 km/hr, further reducing the risk to Moose from vehicle collisions.

The probability of moose/vehicle collisions on the NAR is low. Project-related traffic will be approximately eight trucks per day. The speed limit will be 50 km/h. Given the low traffic and low speed, there is likely a very low probability of Project-related vehicle collisions. Year-round maintenance of the NAR will provide access to non-Project related traffic in winter, south of the Indian River. However, it is unlikely that the level of traffic along the road will substantially increase.

Environment Yukon's (1996b) Moose Management Guidelines state that annual allowable harvest rates for Yukon Moose populations range from 2% to 5% and that annual allowable harvest should not exceed 4% (Environment Yukon 1996b). The Moose population estimates within the GMSs that overlap the W-RAA range from 175 to 463 animals, which corresponds to 170 to 330 Moose/1,000 km² (**Table 4.4-16**). Harvest rates are below the annual allowable harvest in all GMSs that overlap with the W-RAA with the exception of GMS 3-13. The elevated harvest rate may be explained by the easy access from the Stewart River. As noted above, subsistence harvest rates for First Nations are not available, but are expected to be approximately equivalent to licensed harvest rates.

Table 4.4-16 Current Population and Harvest Rates for Moose by Game Management Subzone

Game Management Subzone	Area (km²)	Total Moose	Estimated Moose Density (Moose/1,000 km²)	Average Harvest Rate (% 2006–2015)[a]	Average Kill (2006–2015)[b]
GMS 3-07	1,240	330	265	2.2%	7.2
GMS 3-08	1,382	373	270	1.4%	5.1
GMS 3-10	1,403	463	330	1.1%	5.3
GMS 3-11	1,124	292	260	1.5%	4.4
GMS 3-12	834	225	270	2.9%	6.5
GMS 3-13[c]	978	166	170	4.9%	8.2
GMS 3-14[c]	1,726	293	170	1.1%	3.1
GMS 3-15[d]	907	197	218	0.8%	1.6
GMS 5-02[c]	1,645	280	170	1.3%	3.7

Game Management Subzone	Area (km^2)	Total Moose	Estimated Moose Density (Moose/1,000 km^2)	Average Harvest Rate (% 2006–2015)[a]	Average Kill (2006–2015)[b]
GMS 5-03[c]	1,393	237	170	0.6%	1.5
GMS 5-09[c]	1,028	175	170	0.8%	1.4
Total	**13,660**	**3,032**	**224**	**1.6%**	**48.0**

a Annual average kill / estimated population

b Data from Environment Yukon (2016), Cooley et al. (2012)

c Average population density for the Lower Stewart River West – White Gold Area (O'Donoghue 2013)

d Data were not available for GMS 3-15. Values shown are an average density from adjacent GMSs (3-11, 3-12, 3-13, 3-14); total population was extrapolated from the calculated density.

A recent study investigating the cumulative effects of increased road access within the White Gold Assessment Area, which is centered approximately on the confluence of the White and Yukon rivers and overlaps the Project footprint, predicted an incremental increase in annual harvest rate (Pelchat 2013). The model with best fit found that trail density (an indicator of access) was the only statistically significant variable explaining Moose harvest. Specifically, it was estimated that Moose harvest increased by 3.12 Moose per year for every 1 km increase in trail access per 1 km^2 of area. Road density as a result of the Project (and thus hunter access) will increase from 0.142 to 0.144 km/km^2 within the W-RAA. If it is assumed that roads will have the equivalent effect as trails, this would increase Moose harvest within the W-RAA by 0.006 Moose per year (i.e., 3.12*0.002). Given these data, improved hunting access as a result of improved road access due to the Project is expected to have a minimal effect on Moose harvest rates. In addition, as mentioned above, access gained along the NAR due to the Project will primarily occur during winter because existing portions of the NAR below the Indian River are currently not maintained during winter. However, it is unlikely that the increased access gained from the Project during winter will increase hunting levels because hunting primarily occurs earlier in the season. Furthermore, access gained along the NAR is not anticipated to increase traffic levels substantially along the southern sections of the proposed NAR alignment because access control at the Stewart and Yukon river crossings may be implemented, preventing unauthorized access south of the Stewart River crossing. The NAR will also be closed for portions of the hunting season (i.e., up to 42 days in November to December for the fall freeze-up suspension period, and up to 28 days in April to May for the spring thaw suspension period).

The residual effect of mortality risk to Moose due to vehicle collisions and improved hunting access will likely be adverse in direction and low in magnitude due to low traffic volumes and restricted speed limits on the NAR that will limit collision risk with Moose and the minimal effect on managed Moose harvest rates. The geographic extent will be limited to the Project footprint for vehicle collision risks and regional for the effects of increased hunting pressure. The residual effect will be long-term in duration (but reversible), continuous in frequency, and likely to occur (**Table 4.4-17**). The residual effect was considered not significant and should not pose a risk to the long-term persistence and viability of the Moose population at the regional level (i.e., W-RAA). The context for the residual effect of mortality risk is considered high because Moose populations are expected to be resilient to minimal increases in annual mortality. The level of confidence in the significance determination is high based on well-defined and understood measurable parameters related to mortality.

Table 4.4-17 Effect Characteristics Ratings for the Moose Mortality Rates

Residual Effect Characteristic	Definition	Rating
Direction	Adverse	Increased mortality risk due to collisions between individual Moose and vehicles or improved hunting access would be an adverse effect.
Magnitude	Low	A measurable effect would occur at the individual level if one or a small number of Moose were directly or indirectly killed by Project activities over multiple years. However, the effect would be unlikely to pose a risk to the long-term persistence and viability of the Moose population at the regional level (i.e., W-RAA).
Geographic Extent	Project footprint to Regional	Direct mortality from vehicles may occur for the Project footprint and indirect mortality from hunting may occur at the regional level.
Timing	Year-round	The effect would occur year-round, though vehicle collision risk may be greatest during winter.
Frequency	Continuous	The effect would occur over the life of the Project (i.e., 20 years).
Duration	Long-term	The effect would occur over the life of the Project (i.e., 20 years).
Reversibility	Fully Reversible	The effect would be fully reversible following Reclamation and Closure.
Likelihood	Likely	The probability of an increase in Moose mortality rates due to Project activities is considered likely.

4.4.5.4 Summary of Project–Related Residual Effects and Significance of Residual Effects on Moose

Project-related residual effects and proposed mitigation measures for Moose are summarized in **Table 4.4-18**. Residual effects for Moose include habitat loss due to the Project footprint, reduced habitat effectiveness due to sensory disturbance and mortality risk due to collisions with vehicles and improved hunting access. While habitat loss is expected to only occur during the Construction phase, the remaining residual effects are expected to occur during the Construction, Operation, and Reclamation and Closure phases. The residual effects for Moose were assessed as low in magnitude due to low traffic volumes and restricted speed limits on the NAR and minimal effect on Moose harvest rates (i.e., an increase of 0.006 Moose per year, and licenced harvest is managed) in the W-RAA. The context for Moose is considered high because Moose are likely resilient to habitat disturbance, preferring younger habitats for foraging and Moose are expected to be resilient to minimal increases in annual mortality. Based on these considerations, the Project-related residual effects on habitat and mortality risk for Moose are considered not significant and should not pose a risk to the long-term persistence and viability of the Moose population at the regional level (i.e., W-RAA). The level of confidence in these significance determinations is moderate for habitat effects in consideration of the limited spatial habitat mapping available at the regional level prior to the baseline studies conducted for this Project whereas the level of confidence in the significance determination for mortality risk was high based on well-defined and understood measurable parameters related to mortality.

Table 4.4-18 Summary of Project-related Residual Effects on Moose

Residual Effects	Contributing Project Activities	Proposed Mitigation Measures	Residual Effects Characterization (see Notes for details)										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat Loss and Reduced Habitat Effectiveness	Footprint clearing (Construction) Sensory disturbances from the mine site and NAR (Construction, Operation, Reclamation and Closure)	• Project Design • Minimize Habitat Disturbance	A	L	Local	W	L	C	F	L	H	NS	M
Mortality Risk	Moose-vehicle collisions on the NAR and mine site roads (Construction, Operation, Reclamation and Closure) Improved hunting access due to the NAR (Construction, Operation, Reclamation and Closure)	• Project Design • Project Personnel Wildlife Awareness Orientation • Wildlife Protection Protocols • Manage Traffic • Reduce Barriers to Movement • Prevent Wildlife Entrapment	A	L	Footprint and Regional	Y	L	C	F	L	H	NS	H

Residual Effects Characterization:

Direction: P = Positive, A = Adverse
Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent: Local = Project footprint or ZOI, RAA = Regional, T = Territorial
Timing: Seasonal: (W)inter or (S)ummer, Y= Year-round
Duration: S = Short Term, L = Long-term, P = Permanent
Frequency: I = Infrequent, F = Frequent, C = Continuous
Reversibility: F = Fully Reversible, P = Partially Reversible, I = Irreversible
Context: High = H, Moderate = M, L = Low
Likelihood: U = Unlikely, L = Likely
Significance: NS = Not-Significant, S = Significant
Level of Confidence: H = High, M = Moderate, L = Low

4.4.6 THINHORN SHEEP SUBCOMPONENT

4.4.6.1 Potential Project-related Effects on Thinhorn Sheep

Potential effects on Thinhorn Sheep include habitat loss from the Project footprint, reduced habitat effectiveness from sensory disturbances, mortality risk from vehicle collisions and unmanaged increased harvester access, and alteration to movement in response to the NAR. Potential Project-related effects can occur year-round as Thinhorn Sheep are year-round residents of the TS-RAA. The potential for the NAR to facilitate predation on Thinhorn Sheep is discussed as a Subject of Note in **Section 4.5**

4.4.6.2 Mitigation Measures for Thinhorn Sheep

Mitigation measures that will be used to reduce or eliminate the potential Project-related effects on Thinhorn Sheep include Project Design, Project Personnel Wildlife Awareness Orientation, Minimize Habitat Disturbance, Reduce Human-Wildlife Encounter Risks, Wildlife Protection Protocols, Manage Traffic, Reduce Barriers to Movement, Manage Aircraft Operations, and Prevent Wildlife Entrapment — summaries of which are provided in **Section 4.3** and details in the WPP (**Appendix 31-F**).

Key mitigation measures specific to Thinhorn Sheep include the following:

- Relocation of the airstrip farther away from the Ballarat occurrence area will minimize potential sensory disturbances that could reduce habitat effectiveness.
- Aircraft will maintain a cruising altitude of 500 m above ground when flying over the south-facing slopes above the Yukon River, or maintain a horizontal distance of at least 1,000 m from these slopes to minimize potential sensory disturbances associated with aircraft.
- Road construction will be timed to avoid activity near the Ballarat occurrence area during the lambing season.
- NAR design considerations through the Ballarat occurrence area, which will minimize hindrance to Sheep crossing the road. Specifically:
  - A reduced speed zone of 30 km/hr will be implemented to limit potential risks to Sheep moving through this area.
  - Road design will avoid tall, steep road banks or entrenched ditches that could inhibit Sheep crossing.
  - Snow clearing and piling will minimize hindrance to Sheep crossing the road.

After the successful implementation of these mitigation measures, the following residual effects are expected to remain for Thinhorn Sheep: habitat loss due to the Project footprint, reduced habitat effectiveness due to ground-based sensory disturbance, and alteration to movement. Only ground-based sources of sensory disturbance were carried forward in the assessment because the proposed airstrip (and associated air traffic) will be located more than 5 km from the nearest Sheep occurrence area within the TS-RAA.

Mortality risk due to improved hunting access and collisions with vehicles was not carried forward in the assessment of Project-related effects for Thinhorn Sheep. Predation, disease, and starvation are the primary sources of mortality for Thinhorn Sheep within the TS-RAA. Licensed hunting is not permitted within the GMSs that overlap the Ballarat occurrence area, and harvest by First Nations, while undocumented, is unlikely in the area (i.e., a local land user interviewee was unaware of harvest occurring; Interview 14, Pers. Comm. 2016). Hunting in the Minto area is described as "light" (O'Donoghue and Winter-Sinnott 2014).

Collisions with vehicles would be limited to approximately 3 km of the NAR that are in close proximity to the Ballarat occurrence area. However, the NAR does not overlap with any escape terrain; therefore, potential occurrences of Sheep on the road would likely be restricted to instances where Sheep were travelling across the road either as local movements between the two bluff complexes identified as part of the Ballarat occurrence area, or as part of longer distance movements. Based on the lack of sign observed from ground surveys and trail monitoring in the area and lack of observations from the remote camera studies in the Ballarat valley (Wildlife Field Program Report, **Appendix 16-D**), these types of movements are expected to occur infrequently. The reduced speed zone through the Ballarat occurrence area should mitigate the potential for Sheep-vehicle collisions during these movements.

4.4.6.3 Residual Effects and Significance of Residual Effects on Thinhorn Sheep

Project-related residual effects were assessed based on potential interactions (**Table 4.4-12**). Residual effects include: habitat loss and reduced habitat effectiveness and alteration to movement. This section first provides background information that details the residual effects and then presents the residual effects assessment and significance of residual effects.

Background Information

***Habitat Loss and Reduced Habitat Effectiveness* —** Existing information suggests that occupied Sheep habitat near the Project footprint is limited to the bluff complexes and associated foraging and security habitats on the south aspect hillslopes within the Ballarat occurrence area. Although limited amounts of potentially suitable habitat also exist in sporadic locations along the north side of the Yukon River east and west of the Ballarat occurrence area, no Sheep have been detected between the Ballarat occurrence area and the White River confluence occurrence area 45 km to the west, or the Minto occurrence area 85 km to the east (Russell et al. 2011; Wildlife Baseline Report, **Appendix 16-A**). No escape terrain or high value foraging areas will be directly affected by the Project footprint. However, Project-related sensory disturbances associated with the NAR and Yukon River barge may result in reduced habitat effectiveness within the Ballarat Creek area.

The response of wild Sheep to mines, roads, and other types of human activities in other locations are varied. Responses are often site-specific, can vary with respect to a complex set of variables, and can differ among individual animals in the same area (Papouchis et al. 2001). In many settings, wild Sheep will use areas in proximity to resource developments and roads and will habituate to anthropogenic activities over time. For example, there are several locations where Dall's Sheep and Bighorn Sheep have been documented using active mine areas (Elliott and McKendrick 1984; MacCullum and Geist 1992; Heffelfinger et al. 1995; Oehler et al. 2005; Hebblewhite 2008; Poole et al. 2013). Mines can create suitable conditions for Sheep by creating new escape terrain, increasing forage via reclamation to grass-dominated habitats, and reducing predation and hunting risk (Jansen et al. 2006; Teck 2014). Within a Mine Site, and among different Sheep populations, responses can vary spatially and temporally, from positive to negative to neutral, in response to habitat change and types and intensities of activities (Oehler et al. 2005; Jansen 2006). There are also several locations where wild Sheep have become habituated to roads, such as Dall's Sheep at Sheep Mountain in Kluane National Park (EDI 2015), Stone's Sheep in Muncho and Stone Mountain Provincial Parks in northern British Columbia (Demarchi et al. 2000), and Bighorn Sheep at several locations in the Rocky Mountain National Parks (Bertwistle 1999).

Human activities have also been linked to adverse effects on habitat use by wild Sheep. Although Sheep in some locations habituate to roads, there are also circumstances when roads appear to have adverse effects on Sheep. Roads can impede movement between habitat patches (Cunningham 1982, Ough and deVos 1984) or reduce frequency of habitat use (Papouchis et al. 2013). In one study, radio-collared Bighorn Sheep were located an average distance of 354 m from roads with one or less vehicle per day, and 490 m from roads with 5 to 13 vehicles per day (Papouchis et al. 2001). Short-term displacement of Sheep from security and foraging habitat can occur in response to recreational use (MacArthur et al. 1982; Miller and Smith1985; Papouchis et al 2013). For example, Bighorn Sheep were displaced an average of 100 to 150 m from active roads and trails (Smith et al. 1991). A range of human disturbances associated with rural and urban land use have been associated with habitat abandonment and population declines (Schoenecker and Krausman 2002). Sheep are also very sensitive to disturbance from aircraft, especially helicopters, and will flee from areas when disturbed (Stockwell et al. 1981; Bleitch et al. 1994; Frid 2003).

Responses by Sheep to auditory and visual stimuli associated with human disturbances are quite variable but, in general, the following patterns occur:

- Effects increase with proximity of the disturbance to Sheep.
- Effects increase with magnitude of the disturbance (e.g., noise volume).
- Effects are greater when the disturbance is above Sheep rather than below them.
- Effects are greater in response to occasional, random disturbances than to regular or continuous disturbances.

- Effects may be greater during the middle of the day when Sheep are resting and ruminating compared to the morning and evening when Sheep tend to be more active (Frid 2003).

Alteration to Movement — The population dynamics and movement patterns of Thinhorn Sheep in the Ballarat occurrence area and surrounding region are unknown. However, the number of Thinhorn Sheep in this area is much smaller than what is normally considered a minimum viable population (Berger 1990; Beissinger and Westphal 1998) without at least occasional emigration from other sources. As discussed in **Section 3.3.4**, the characteristics of Thinhorn Sheep occurrences along the Yukon River share similarities with other Sheep populations described as having metapopulation structures (Bleich et al. 1990; Akçakaya et al. 2007). In those populations, movement corridors were identified as important for maintaining and recolonizing discrete Sheep subpopulations (Schwartz et al. 1986).

If Thinhorn Sheep do conduct occasional movements among the Yukon River occurrence areas, the movement corridor is likely along the series of steep hills and ridges on the north side of the Yukon River valley. These hills and ridges include patches of suitable escape terrain and foraging habitat and frequently adjoining ridges that Sheep typically use for traveling (Geist 1971). Evidence of Sheep actually using this potential corridor has not been observed; however, if only occasional movements occur, sign would be expected to be low. During four aerial surveys between 2010 and 2016 along the Yukon River hillslopes between the Minto occurrence area and the White River confluence area, no Thinhorn Sheep were detected outside of the known occurrence areas (Russell et al. 2011; Wildlife Field Program Report, **Appendix 16-D**). However, several wildlife trails were observed outside of the occurrence areas during aerial surveys, and during the winter survey, occasional ungulate tracks were also observed that could not be differentiated as Deer or Sheep tracks (Wildlife Field Program Report, **Appendix 16-D**).

Within the Ballarat occurrence area, local movements of Sheep between the various bluff complexes, including the bluffs on either side of Ballarat Creek, are assumed to occur. During aerial surveys, Thinhorn Sheep were observed on multiple bluffs within the Ballarat occurrence area, including both east and west of Ballarat Creek indicating that local movements do occur. Ground surveys documented wildlife trails coming down the bluffs both east and west of Ballarat Creek, although the trails appear to be used by many species and are not Sheep-specific. Ground surveys and trail monitoring in the Ballarat Creek area noted a lack of Sheep sign along the lower slopes and in the Ballarat Creek valley. Remote cameras were installed on the wildlife trails coming down off the bluffs in 2015; however, to date, no Sheep have been captured on these or other remote cameras in the Ballarat Creek valley (Wildlife Field Program Report, **Appendix 16-D**). Based on the lack of sign observed from ground surveys and remote camera studies in the Ballarat valley, Sheep movements across the Ballarat Creek valley are expected to occur infrequently. However, based on the aerial survey results, annual or possibly seasonal, movements are expected.

Assuming Thinhorn Sheep are moving along this potential movement corridor, Project-related sensory disturbances (most notably the NAR, which bisects the series of hillslopes in the Ballarat Creek valley) could affect movements by Thinhorn Sheep (Papouchis et al. 2001; Epps 2005).

Habitat Loss and Reduced Habitat Effectiveness

Habitat loss for Thinhorn Sheep was assessed quantitatively by calculating the amount of high suitability habitat (i.e., habitat rated as moderate or high suitability for Thinhorn Sheep) within the TS-RAA that will be directly lost from the Project footprint or have reduced habitat effectiveness using a ZOI approach (**Section 2.0**). High suitability habitat within the TS-RAA is based on the HSI developed for Thinhorn Sheep (Thinhorn Sheep Habitat Suitability Report, **Appendix 16-C3**). The ZOI widths for Thinhorn Sheep discussed in the literature vary widely depending on multiple factors such as the type of disturbance (e.g., trails versus high traffic roads), the type of response evaluated, study methodology, and local environmental factors. A 500 m ZOI around the Mine Site and NAR was selected for Thinhorn Sheep, which corresponds to the distance Sheep may respond to ground-based disturbances (MacArthur et al. 1982; Smith et al. 1991; Papouchis et al. 2001; Gaines et al. 2003).

The HSI model for Thinhorn Sheep used slopes >35 degrees (i.e., potential escape terrain), warm aspects, distance from escape terrain, land cover (i.e., potential foraging habitat), and distance from the Yukon River to predict suitable Thinhorn Sheep habitat. The outputs were classified into four habitat classes corresponding to relative habitat quality: nil (unsuitable), low (suitability unknown), moderate (suitable but suboptimal), and high (optimal). Suitable habitats for Thinhorn Sheep were identified in relatively small extents and were concentrated on steep, non-forested, south-facing slopes with rocky bluff complexes, such as along the north side of the Yukon River. The results of the HSI correspond well with the three known Sheep occurrence areas in the region and identified several other potential habitat areas between them.

The Project could directly affect 0.09 km² of Thinhorn Sheep high suitability habitat within the TS-RAA, which represents 0.17% of the high suitability habitat available within the TS-RAA (**Table 4.4-19**). This direct habitat loss corresponds to where the NAR traverses near the base of a steep hillslope west of Ballarat Creek. An additional 2.48 km² of high suitability habitat within the ZOI could experience reduced habitat effectiveness, which represents 4.87% of the available Thinhorn Sheep high suitability habitat within the TS-RAA. The combined residual effect of habitat loss and reduced habitat effectiveness could affect up to 5.04% of Thinhorn Sheep high suitability habitat within the TS-RAA.

Table 4.4-19 Area of Habitat Loss and Reduced Habitat Effectiveness for Thinhorn Sheep

Habitat Class	Total area in TS-RAA	Habitat Loss		Reduced Habitat Effectiveness		Total Suitable Habitat Altered	
	km²	km²	%	km²	%	km²	%
High	14.50	0.00	0.00	1.07	7.40	1.07	7.40
Moderate	36.39	0.09	0.23	1.41	3.86	1.49	4.10
Total Suitable Habitat	**50.89**	**0.09**	**0.17**	**2.48**	**4.87**	**2.56**	**5.04**

*Percentages are based on the proportion of each habitat class within the TS-RAA.

The residual effects of habitat loss and reduced habitat effectiveness on Thinhorn Sheep will be adverse in direction, low in magnitude, local in geographic extent, long-term in duration (but reversible), and frequent (**Table 4.4-20**). The primary Project-related residual effect will occur within the Ballarat occurrence area due to ground-based sensory disturbance associated with Project activities along the NAR and Yukon River barge operations. The total high suitability habitat altered from the Project will be low in magnitude because Project activities will have a minimal direct effect on Thinhorn Sheep habitat (0.17%) and reduced habitat effectiveness will be low (4.87%), which combined is less than the 10% threshold for low magnitude effects as defined in **Section 4.4.1**. Furthermore potential disturbances that may reduce habitat effectiveness will be limited by distance from habitat areas and visual and auditory screening provided by forest vegetation and terrain. The geographic extent of the residual effects will be limited to the ZOI overlapping the Ballarat Creek Sheep occurrence area, and the timing of the residual effects will be year-round. The duration of the residual effects will be long-term over the life of the Project (i.e., >20 years), but reversible following Reclamation and Closure. The residual effects will be frequent with sensory disturbance associated with the Project (e.g., vehicle traffic) likely to occur several times a day, most days of the year. The probability of the residual effects occurring was considered likely. The context was considered high because Thinhorn Sheep populations are secure in Yukon (Environment Yukon 2016c), there is no known harvest of Sheep in the TS-RAA (**Section 3.3.4**) and wild Sheep in other areas have adapted to similar types of sensory disturbance. Based on these considerations, the residual effects on high suitability habitat for Thinhorn Sheep were rated as not significant and should not pose a risk to the long-term persistence and viability of the Thinhorn Sheep population at the regional level (i.e., TS-RAA). The level of confidence in this significance determination is moderate due to uncertainty regarding the response of Sheep to sensory disturbance associated with the Project.

Table 4.4-20 Effect Characteristics Ratings for the Thinhorn Sheep – Habitat Effectiveness

Residual Effect Characteristic	Definition	Rationale for Rating
Direction	Adverse	The loss of effective Thinhorn Sheep habitat due to the Project footprint and sensory disturbance would be adverse.
Magnitude	Low	Project activities would have a minimal direct effect on Thinhorn Sheep habitat (0.17%). Potential disturbances that may reduce habitat effectiveness would be limited by distance from habitat areas and visual and auditory screening provided by forest vegetation and terrain (4.87%).
Geographic Extent	Local	Habitat loss would be limited to the Project footprint, and reduced habitat effectiveness would be limited to the ZOI associated with the Ballarat Creek Thinhorn Sheep occurrence area.
Timing	Year-round	Both Thinhorn Sheep and Project-related effects are expected to occur within the ZOI year-round.
Frequency	Continuous	Disturbances associated with the Project (e.g., vehicle traffic) are likely to occur several times a day, most days of the year.
Duration	Long-term	Disturbances associated with the Project will occur over the life of the Project (i.e., >20 years).
Reversibility	Fully Reversible	Habitat effects would be fully reversible following Reclamation and Closure.
Likelihood	Likely	Thinhorn Sheep and effective habitat are known to occur within the Project footprint and ZOI.

Alteration to Movement

Information to quantitatively assess the residual effect of alteration to movement on Thinhorn Sheep is limited. There is uncertainty regarding how often Thinhorn Sheep may be making east-west movements across the Ballarat Creek valley, and uncertainty regarding how Thinhorn Sheep may respond to Project-related disturbances. As such, the residual effect was assessed qualitatively based on information from the literature and a professional assessment of how this information may relate to Projects effects on Thinhorn Sheep movement.

The north side of the Yukon River is lined by a series of steep hills and ridges that may be used as a movement corridor by Sheep among the White River, Ballarat, and Minto occurrence areas. Movement of Sheep among these areas is suspected based on the persistence of small groups of Sheep along this corridor (i.e., the Ballarat and White River occurrence areas); however, baseline surveys did not identify any Sheep moving among these areas (Wildlife Field Program Report, **Appendix 16-D**). Within the Ballarat occurrence area, localized movement of Sheep between bluffs is assumed to occur based on the location of Sheep during various Project surveys; however, based on ground survey and remote camera data, movement across the Ballarat Creek valley is expected to be infrequent. If movement does occur, Project-related sensory disturbances (most notably from the NAR, which bisects the series of hillslopes) may affect Sheep movements (Papouchis et al. 2001; Epps 2005).

The residual effect of alteration to movement on Thinhorn Sheep will likely be adverse in direction, low in magnitude, local in geographic extent, long-term in duration (but reversible), and infrequent (**Table 4.4-21**). The residual effect will be low in magnitude because it will be indirect and available information suggests that Sheep movements are infrequent. The geographic extent of the residual effects will be limited to the NAR footprint and ZOI overlapping the Ballarat Creek Sheep occurrence area. The timing of the residual effect will be year-round, although long distance movements by Sheep are more likely to occur in the summer than in the winter (Geist 1971). The frequency of the residual effect will be infrequent because Sheep movements through the ZOI are only expected to occur for a limited number of times a year. The duration of the residual effects will be long-term over the life of the Project (i.e., >20 years), but fully reversible following Reclamation and Closure. The probability of the residual effect occurring was considered likely with the assumption that Thinhorn Sheep make east-west movements across the Ballarat Creek valley. The context was considered high because Thinhorn Sheep populations are secure in Yukon (Environment Yukon 2016c), there is no known harvest of Sheep in the TS-RAA (**Section 3.3.4**) and there is an existing road through the Ballarat Creek valley (although traffic monitoring indicated that baseline use of the existing road was limited to occasional Project-related UTV traffic; Wildlife Field Program Report, **Appendix 16-D**).

The residual effect on Thinhorn Sheep was rated as not significant because of it is a low magnitude effect that would be fully reversible with Reclamation and Closure and should not pose a risk to the long-term persistence and viability of the Thinhorn Sheep population at the regional level (i.e., TS-RAA). The level of confidence in this significance determination is moderate because there is uncertainty as to the degree (if any) that Sheep movements will be affected by the Project. In some areas, wild Sheep regularly cross roads, while in other areas roads appear to hinder Sheep movements (Papouchis et al. 2001; Epps 2005).

Table 4.4-21 Effect Characteristics Ratings for the Thinhorn Sheep Risk – Alteration to Movement

Residual Effect Characteristic	Definition	Rationale for Rating
Direction	Adverse	Alteration to movement patterns for Thinhorn Sheep (notably related to use of the NAR) would be an adverse effect.
Magnitude	Low	The magnitude of the effect would be low. Available information suggests that Thinhorn Sheep movements are infrequent across the NAR.
Geographic Extent	Local	The effect on Thinhorn Sheep movement would likely be limited to the Ballarat Creek area. It is unlikely that the effect on movement would extend beyond this area of interaction.
Timing	Year-round	Both Thinhorn Sheep and Project-related effects are expected to occur in the ZOI year-round, although movements by Thinhorn Sheep are less likely in the winter.
Frequency	Infrequent	Thinhorn Sheep movements through the ZOI are only expected to occur for a limited number of times a year.
Duration	Long-term	Disturbances associated with the Project will occur over the life of the Project (i.e., >20 years).
Reversibility	Fully Reversible	The effect would be fully reversible following Reclamation and Closure.
Likelihood	Likely	Uncertainty as to the degree (if any) that Sheep movements will be affected by the Project. Due to uncertainty, assumed that movements will be affected.

4.4.6.4 Summary of Project–Related Residual Effects and Significance on Thinhorn Sheep

Project-related residual effects and proposed mitigation measures for Thinhorn Sheep are summarized in **Table 4.4-22**. Residual effects for Thinhorn Sheep include habitat loss due to the Project footprint, reduced habitat effectiveness due to ground-based sensory disturbance, and alteration to movement. Habitat loss will be very minimal and is expected to occur during the Construction phases whereas reduced habitat effectiveness will be minimal and is expected to occur during the Construction, Operation, and Reclamation and Closure phases. Alteration to movement would occur during Construction, Operations and Reclamation and Closure phases. The context for Thinhorn Sheep was considered high because Thinhorn Sheep populations are secure in Yukon (Environment Yukon 2016c) and there is no known harvest of Sheep in the TS-RAA (**Section 3.3.4**). Based on these considerations, the residual effects for Thinhorn Sheep were assessed as low in magnitude and were therefore considered to be not significant and should not pose a risk to the long-term persistence and viability of the Thinhorn Sheep population at the regional level (i.e., TS-RAA). The level of confidence in these significance determinations was moderate due to uncertainty and variability in Thinhorn Sheep responses to sensory disturbance and limited information on local Sheep movements.

Table 4.4-22 Summary of Project-related Residual Effects on Thinhorn Sheep

Residual Effects	Contributing Project Activities	Proposed Mitigation Measures	Residual Effects Characterization (see Notes for details)										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat Loss and Reduced Habitat Effectiveness	Footprint clearing of the NAR (Construction) Barge operations on the Yukon River (Construction and Operation) Ground-based sensory disturbances from the mine site and NAR (Construction, Operation, Reclamation and Closure)	• Project Personnel Wildlife Awareness Orientation • Minimize Habitat Disturbance • Wildlife Protection Protocols • Manage Traffic • Manage Aircraft Operations	A	L	Local	Y	L	C	F	L	H	NS	M
Alteration to Movement	NAR (Construction, Operation, Reclamation and Closure)	• Project Design • Project Personnel Wildlife Awareness Orientation • Manage Traffic • Reduce Barriers to Movement	A	L	Local	Y	L	I	F	L	H	NS	M

Residual Effects Characterization:

Direction: P = Positive, A = Adverse

Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude

Geographic Extent: Local = Project footprint or ZOI, RAA = Regional, T = Territorial

Timing: Seasonal: (W)inter or (S)ummer, Y= Year-round

Duration: S = Short Term, L = Long-term, P = Permanent

Frequency: I = Infrequent, F = Frequent, C = Continuous

Reversibility: F = Fully Reversible, P = Partially Reversible, I = Irreversible

Context: High = H, Moderate = M, L = Low

Likelihood: U = Unlikely, L = Likely

Significance: NS = Not-Significant, S = Significant

Level of Confidence: H = High, M = Moderate, L = Low

4.4.7 GRIZZLY BEAR SUBCOMPONENT

4.4.7.1 Potential Project-Related Effects on Grizzly Bear

Potential effects on Grizzly Bear include habitat loss from the Project footprint, reduced habitat effectiveness from sensory disturbances, increased mortality risk from increased human-bear encounters, and alteration to movement in response to Project infrastructure. Three habitat components were used to assess the potential Project-related effects on habitat loss and reduced habitat effectiveness: growing season habitat, security areas habitat, and denning habitat. Potential Project-related effects can occur year-round as Grizzly Bear are year-round residents of the W-RAA, and can occur during Construction, Operation, and Reclamation and Closure phases.

4.4.7.2 Mitigation Measures for Grizzly Bear

The potential adverse effects of the Project on Grizzly Bear are reduced or eliminated by a combination of mitigation measures that will be applied throughout the life of the Project. Mitigation measures applicable to the potential Project-related effects on Wildlife and Wildlife Habitat are summarized above in **Table 4.3-1**. Mitigation measures specific to Grizzly Bear include: Project Design, Project Personnel Wildlife Awareness Orientation, Minimize Habitat Disturbance, Reduce Human-Wildlife Encounter Risks, Wildlife Protection Protocols, Manage Traffic, and Manage Aircraft Operations — summaries of which are provided in **Section 4.3** and details in the WPP (**Appendix 31-F**).

Key mitigation measures specific to Grizzly Bear include the following:

- Waste management including incineration of food waste daily.
- In the event of bear encounters, several types of bear deterrents will be used (e.g., noise makers such as bear bangers, air horns). Firearms will only be used as a last resort in the event of a bear encounter when all other methods of bear deterrents have failed. If wildlife becomes a concern, Yukon Conservation Officer Services will be contacted for advice on appropriate actions.
- A no hunting policy.
- Speed limit on roads to reduce wildlife/vehicle (mortality) risk.

Following successful implementation of these mitigation measures, the residual effects on habitat loss and reduced habitat effectiveness are expected to remain while the potential effects mortality risk and alteration to movement are expected to be eliminated through mitigation, as described below.

Mortality Risk — Throughout most of the species' range in North America, direct human-caused mortality plays a large role in the dynamics of Grizzly Bear populations. For example, in the mountains of southern Alberta, interior BC, northern Montana, Idaho, and Washington, humans caused 77% of known mortalities of radio-collared Grizzly Bears (McLellan et al. 1999). Even when high quality habitat is abundant, populations can still decline if harvest rates — including kills from defense of life or property, road kills, and poaching — are cumulatively unsustainable (Maraj 2007). Therefore, mortality risk was assessed as a potential Project-related effect and its pathways that could be influenced by the Project included: human-wildlife encounters, vehicle collisions, and increased illegal hunting.

In Yukon, an estimated 10 to 15 grizzly bears are killed because of conflict with humans every year (MPERG 2008). Improper handling of food and garbage can attract scavengers, including bears, into camps and areas near people. Approximately 70% of reported human-bear conflicts are due to garbage attraction (MPERG 2008). The primary mitigation for this potential effect is waste management that is incorporated into Project design including incinerating food waste on a daily basis. Measures as described in a waste management plan, supported by the mitigation measures Reduce Human-Wildlife Encounter Risks and Project Personnel Wildlife Awareness Orientation will result in avoiding human-caused mortality of Grizzly Bear related to human-wildlife encounters during the Project.

Grizzly Bear mortalities can also include vehicle collisions. Since 2003, a total of 15 Grizzly Bear collisions with vehicles were reported on Yukon highways and the collisions occurred on the Alaska Highway, Klondike Highway, Nahanni Range Road and Tagish Road. The highest number of collisions with Grizzly Bear occurred in 2007 and 2010 (n=3 for both years). All recorded Grizzly Bear collisions occurred between April and October, with the majority occurring between June and September (EDI 2015). Due to the low number of Project-related vehicles anticipated on the NAR (i.e. 8 trucks/day) and the current low occurrence of Grizzly Bear interacting with the proposed Mine Site roads and NAR (four Grizzly Bear were observed over two years of remote camera studies; Wildlife Field Program Report, **Appendix 16-D**), the probability of vehicle collisions with Grizzly Bear is expected to be low. Furthermore, any additional vehicle collisions due to the Project will be avoided with implementation of road signage and speed limits as described in **Section 4.3**.

Grizzly Bear mortalities can also include hunting. Grizzly Bear is recognized as a big game species in Yukon's hunting regulations; it is a prized trophy hunting species and is actively hunted in Yukon. Hunting licenses are required by YG, as well as adherence to the general and species-specific regulations. In Yukon, all cubs and female grizzly bears with cubs, yearlings, and two-year olds are protected from hunting as populations are better able to sustain a harvest of primarily males (Environment Yukon 2015a). Clearing along roadsides can promote growth of forage species which can attract bears making them vulnerable to hunters (Simpson 1987). Increased road access can also lead to increased access for hunters. As described in the baseline report (Wildlife Baseline Report, **Appendix 16-A**), a total of six Grizzly Bears were harvested from GMSs within the W-RAA between 2006 to and 2015. One other mortality was also recorded within the W-RAA in GMS 311. It is expected that potential adverse effect on hunting caused by the Project will be avoided by enforcing no hunting rules for any Project workers and the hunting regulations will continue to manage the overall number of Grizzly Bear harvested in the GMSs. Furthermore, the primary access gained with the Project is in winter when the NAR will be plowed. Since Grizzly Bear are not active in winter and hunting does not occur, this further reduces the likelihood of increased mortality from hunting caused by the Project. Therefore there is not a residual effect on mortality risk related to increased access for hunting caused by the Project.

Alteration to Movement — Grizzly Bear movement and/or behaviour is a potential Project-related effect through the life of the Project because Grizzly Bears tend to avoid areas disturbed by humans. Grizzly Bears usually avoid areas with human activity, such as active roads and industrial sites by enough distance so that they are not disturbed (Harding and Nagy 1980, Aune et al. 1986, Mattson et al. 1987). The distance of avoidance is largely dependent on the individual bear and its past experience with humans (McLellan 1989). Human disturbance, including road use, has been shown to cause individual and social disruption (Benn and Herrero 2002, Apps et al. 2004, Mueller et al. 2004); and habitat avoidance and disruption (McClellan and Shackleton 1988, Gibeau et al. 2001, Apps et al. 2004). Roads and industrial activity can disrupt bears from their natural movement patterns. Roads with regular vehicle use can act as a barrier to Grizzly Bear movement (EDI 2008). Proctor et al. (2002) found that female Grizzly Bears rarely crossed a major highway in BC and movement of bears across the road was reduced considerably. In Yellowstone National Park, Mattson et al. (1987) noted that Grizzly Bears avoided habitat within 500 m of roads during the spring and summer and within 3 km of a road during the fall. In Montana, Grizzly Bear use was substantially reduced in areas within 500 m of roads during the spring and summer and in the fall, avoidance was observed up to 1,000 m from a road (Aune et al. 1986). When a seasonal closed road was opened, the mean distance of bears from roads increased from 655 m to 1,222 m (Kasworm and Manley 1990). Some disturbed habitats may attract bears such as road right-of-ways (Chruszcz et al. 2003; Roever et al. 2008a; 2008b; Graham et al. 2010), although this use may be affected by traffic volume (Waller and Servheen 2005).

Alteration to movement due to Project infrastructure and activities was not carried forward in the assessment of Project-related effects because Grizzly Bear have relatively large home ranges and the increase in road density within the W-RAA due to the Project is negligible. Road density within the W-RAA will increase from 0.142 km/km² to 0.144 km/km² due to the Project. Grizzly bears occur in low density in the area and were infrequently observed in the vicinity of the road based on baseline data; therefore the potential of interaction with the road is low. The Grizzly Bear linkage zone prediction model also showed a very small degree of habitat change would result from the Project (Grizzly Bear Habitat Model Report, **Appendix 16-C4**). This model showed that Project-related development will have an effect on 0.1% of effective Grizzly Bear linkage zone habitat within the W-RAA. Mitigation measures have been incorporated into the Project design to minimize potential adverse effects or loss of effective habitat for wildlife species. There will not be a residual effect resulting in measurable alteration of movement to Grizzly Bears due to the Project.

4.4.7.3 Residual Effects and Significance of Residual Effects

Project-related residual effects were assessed based on potential interactions (**Table 4.1-2**). Residual effects include: direct habitat loss and reduced habitat effectiveness. In the context of Grizzly Bear occurrence within the W-RAA and Project-related activities within the W-RAA, these Project-related residual effects were assessed using three measures of Grizzly Bear habitat: habitat effectiveness (measures effective growing season habitat, security areas habitat, and denning habitat. Characterization is presented for each of the three measures providing the overall significance characterization of the two residual effects. This section first provides background information that details the residual effects and then presents the residual effects assessment and significance of residual effects.

Background Information

Habitat Loss and Reduced Habitat Effectiveness — Human activities influence how bears use potential habitat; zones of human activity are generally avoided or characterized by high human-caused mortality (McLellan and Shackleton 1988, McLellan 1989). Reduction in habitat use by Grizzly Bears can extend over a land area much larger than that occupied by the development itself.

The Project has the potential to affect habitat availability as a direct loss from construction of the Project footprint or as an indirect loss from sensory disturbance within a ZOI. Assessments of Grizzly Bear habitat commonly apply indicators of functional habitat loss in consideration of the effects of human activities (Gibeau 1998, Gibeau 2000, COSEWIC 2012). The Grizzly Bear habitat effectiveness (HE) model quantified the effective habitat available in two scenarios: baseline (existing disturbance) and post-Project conditions. The inputs were topography, vegetation, and disturbance, which was buffered by a ZOI of 400 m or 800 m depending on disturbance type. This is one component that was used to measure habitat change and evaluate residual effects. Effective Grizzly Bear home ranges encompass a combination of foraging, security, and denning habitat. Grizzly Bear habitat associations are strongly seasonal and typically reflect local plant development and prey concentrations (COSEWIC 2012). Yukon Grizzly Bears use a variety of habitats, including boreal forest, alpine and subalpine, and arctic tundra (Environment Yukon 2015b); however, bears were seldom found at elevations higher than 1,900 m in studies conducted in the southwest Yukon (Maraj 2007). Grizzly Bears are opportunistic omnivores and vary their diets based on seasonal food availability. The primary food source for Grizzly Bears is vegetation, but they will also prey on animals opportunistically. The other main food sources in the spring include overwintered berries, roots, and winter-killed carcasses (Environment Yukon 2015b). Within Yukon, Grizzly Bears are the primary predator of Moose calves in the spring (Larsen et al. 1989). Throughout the summer and fall, Grizzly Bears feed largely on grasses, horsetail, and berries when they become available (Environment Yukon 2015b).

Security areas habitat is important for bears, and typically consists of an area of suitable habitat that is large enough to meet minimum daily area requirements for foraging and is outside the ZOI of human activity. Connectivity of small areas of suitable habitat is likely necessary for continued occupancy by grizzly bears (Proctor et al. 2005, COSEWIC 2012). Grizzly Bears, particularly females with cubs, require large, intact areas where they can safely forage away from humans for 24 to 48 hours (Purves and Doering 1998). Having large, secure areas to forage reduces habituation of bears to humans (Gibeau et al. 1996). Based on the work by Gibeau in Banff National Park, Purves and Doering (1998) used a threshold of 9 km^2 as the smallest contiguous habitat unit that could be considered secure (Grizzly Bear Habitat Model Report, **Appendix 16-C4**). The ZOI distance of 500 m was used to exclude areas of human disturbance that met a threshold level of activity from the resultant "secure habitat". This is consistent with methods used by Purves and Doering (1998).

In Yukon, denning occurs between October and April/May but can extend into June in years with late snow. Suitable denning habitat is critical for bears to survive the long, cold Yukon winters. Denning habitat is typically located at high elevation, sloped areas that have dry, stable soil conditions that remain frozen during the winter and areas with natural caves (Bunnell and McCann 1993). Bears hibernate in dens which are often excavated in alpine or subalpine slopes. Other characteristics of suitable denning habitat include areas with a lack of permafrost, low soil moisture, deep soils, and vegetation root structures. All of these characteristics contribute to dry and stable den sites (Grizzly Bear Habitat Model Report, **Appendix 16-C4**).

Grizzly Bears have been found to be sensitive to disturbance during the denning period. Denning grizzlies were found to have an increased heart rate of 12 to 26 beats per minute to 64 beats per minute when disturbed by seismic activities (Reynolds et al. 1986). Disturbance to denning bears can elevate their energy use due to increased movement in the den (Reynolds et al.1986) that can lead to den abandonment (Craighead and Craighead 1972, Reynolds et al. 1976, Harding and Nagy 1980), potential loss of cubs (Schoen et al. 1987), and displacement from denning areas (Craighead and Craighead 1972, Schoen et al. 1987). Conversely, Linnell et al. (2000) found that bears readily den within 1 to 2 km of human activity and appear to be undisturbed by most activities that occur at distances greater than 1 km. Activity closer than 1 km and especially within 200 m has variable effects; however, there is a risk that activity within this zone can lead to den abandonment, especially early in the denning season (Linnell et. al. 2000). With this rationale, the ZOI for denning habitat was set at the conservative estimation of 1 km around all disturbance types with human activity during the winter.

Habitat Loss and Reduced Habitat Effectiveness

The residual effects of the Project on Grizzly Bear habitat loss and reduced habitat effectiveness were assessed using three models: habitat effectiveness (HE), security areas, and denning habitat. Both types of habitat change (habitat loss and reduced effectiveness) were measured within the models for HE and security areas, whereas for denning habitat the former ZOI method described in **Section 2.0** was applied.

The suitable denning habitat and disturbance intersections provided the area of suitable denning habitat lost due to the Project footprint and the area of suitable denning habitat reduced by sensory disturbances within the ZOI as two separate outputs.

Habitat Effectiveness — Methods for the HE model were adapted from Maraj (2007) and Purves and Doering (1998). The potential habitat component is the amount of seasonal habitat given the natural biophysical conditions. The disturbance component identifies areas that may be unavailable or have reduced habitat quality as a result of human disturbance, and the remaining area is the realized habitat at baseline condition. Realized habitat was calculated for the baseline (existing disturbance) and post-Project condition. The calculations of realized habitat consider direct and indirect habitat loss, and the model uses a ZOI of 400 m or 800 m depending on disturbance type.

Potential and realized habitat were calculated for green-up (peak greenness in July, based on imagery from July 22, 1994) and for green-down (senescence in September, based on imagery from September 4, 2010) within each of the 28 Bear Management Units (BMUs) in the W-RAA. A portion of the W-RAA in the southeast corner (363.1 km^2) did not have Landsat Imagery coverage and therefore that section was not included in the habitat effectiveness model. Refer to the Grizzly Bear Habitat Model Report (**Appendix 16-C4**) for further description of the BMUs and model methods.

The percent change of effective habitat between baseline and post-Project conditions was assessed within each of the 28 BMUs within the W-RAA. The percentage of effective habitat for both the green-up (**Table 4.4-23**) and green down (**Table 4.4-24**) period was reduced by 1.0% for the entire W-RAA compared to baseline condition. With respect to the BMUs at baseline compared to post-Project, reduction in effective habitat will occur in 23 of the 28 units for both the green-up and green down with the greatest change occurring in BMUs 10 and 22. Within BMU 10, 6.3% of effective habitat will be altered during both green-up and green-down, and within BMU 22, 4.3% and 4.2% of effective habitat will be altered during green-up and green-down.

Table 4.4-23 Change in Potential Effective Grizzly Bear Habitat during Green-up due to Project Effects by BMU

BMU	Potential Habitat Value	Realized Habitat Value – Baseline	% of Effective Green-up Habitat – Baseline	Realized Habitat Value – Post-Project	% of Effective Green-up Habitat – Post-Project	% Change
1	148517.7	100179.9	67.5	99833.8	67.2	-0.2
2	90300.9	87615.5	97.0	87614.1	97.0	<-0.1
3	99030.6	86999.6	87.9	86992.3	87.8	<-0.1
4	158184.7	116480.4	73.6	115981.5	73.3	-0.3
5	126062.3	108264.4	85.9	108239.8	85.9	<-0.1
6	139749.9	139180.3	99.6	139179.7	99.6	<-0.1
7	76719.7	59303.7	77.3	57313.5	74.7	-2.6
8	85497.6	79215.3	92.7	79168.3	92.6	-0.1
9	79268.8	74660.1	94.2	73211.8	92.4	-1.8
10	83695.5	80227.6	95.9	74949.5	89.6	-6.3
11	90249.8	84386.5	93.5	83175.4	92.2	-1.3
12	81511.9	81510.8	100.0	81510.8	100.0	0.0
13	93140.9	93050.4	99.9	93050.4	99.9	<-0.1
14	124383.6	108388.7	87.1	103818.8	83.5	-3.7
15	98705.4	96369.0	97.6	96178.1	97.4	-0.2
16	71947.8	69076.5	96.0	69074.1	96.0	<-0.1
17	64178.6	61506.8	95.8	61504.9	95.8	<-0.1
18	150482.9	150482.9	100.0	150482.9	100.0	0.0
19	95603.0	93566.6	97.9	93567.3	97.9	<-0.1
20	93113.2	90857.7	97.6	90492.0	97.2	-0.4
21	111119.3	103165.1	92.8	102735.9	92.5	-0.4
22	102290.9	96689.5	94.5	92307.6	90.2	-4.3
23	60529.1	60240.4	99.5	60239.7	99.5	<-0.1
24	84953.8	84953.8	100.0	84953.8	100.0	0.0
25	103678.9	103678.9	100.0	103678.9	100.0	0.0
26	123056.1	115895.0	94.2	111892.1	90.9	-3.3
27	81377.0	81377.0	100.0	81377.0	100.0	0.0
28	117689.5	108576.8	92.3	103994.1	88.4	-3.9
TOTAL	**2,835,039.7**	**2,615,898.9**	**92.3**	**2,586,518.2**	**91.2**	**-1.0**

Note: Numbers represent amount of effective habitat in the W-RAA but are not area measurements (unit-less).

Table 4.4-24 Change in Potential Effective Grizzly Bear Habitat during Green-down due to Project Effects by BMU

BMU	Potential Habitat Value	Realized Habitat Value – Baseline	% of Effective Green-up Habitat – Baseline	Realized Habitat Value – Post-Project	% of Effective Green-up Habitat – Post-Project	% Change
1	280961.4	187507.2	66.7	186803.1	66.5	-0.3
2	169529.6	164699.5	97.2	164697.1	97.1	<-0.1
3	208708.1	183171.0	87.8	183153.2	87.8	<-0.1
4	338957.2	246391.3	72.7	245329.6	72.4	-0.3
5	283509.8	244369.3	86.2	244321.5	86.2	<-0.1
6	260322.0	259217.8	99.6	259216.8	99.6	<-0.1
7	161421.2	122283.0	75.8	118589.6	73.5	-2.3
8	163990.8	151577.4	92.4	151459.3	92.4	-0.1
9	147423.8	138148.2	93.7	135314.7	91.8	-1.9
10	152766.7	146323.9	95.8	136646.4	89.4	-6.3
11	137646.1	128375.8	93.3	126193.0	91.7	-1.6
12	148252.5	148251.5	100.0	148251.5	100.0	0.0
13	195059.3	194840.6	99.9	194840.4	99.9	<-0.1
14	242711.0	210683.3	86.8	201549.6	83.0	-3.8
15	205515.0	200395.5	97.5	199927.9	97.3	-0.2
16	153256.4	146682.8	95.7	146677.6	95.7	<-0.1
17	143161.3	136999.9	95.7	136995.8	95.7	<-0.1
18	294771.6	294771.6	100.0	294771.6	100.0	0.0
19	191696.4	186924.4	97.5	186925.8	97.5	<-0.1
20	165513.9	160088.5	96.7	159401.9	96.3	-0.4
21	215126.7	199098.9	92.5	198205.9	92.1	-0.4
22	194066.0	182810.5	94.2	174615.6	90.0	-4.2
23	112448.3	111701.8	99.3	111699.9	99.3	<-0.1
24	141983.4	141983.4	100.0	141983.4	100.0	0.0
25	199720.0	199720.0	100.0	199720.0	100.0	0.0
26	225060.5	210108.8	93.4	202471.4	90.0	-3.4
27	162113.4	162113.4	100.0	162113.4	100.0	0.0
28	201964.5	185949.7	92.1	178571.3	88.4	-3.7
TOTAL	**5,497,657.0**	**5,045,188.9**	**91.8**	**4,990,447.2**	**90.8**	**-1.0**

Note: Numbers represent amount of effective habitat in the W-RAA but are not area measurements (unit-less)

Security Areas — Residual effects of habitat loss and reduced habitat effectiveness were also assessed using the security areas habitat. The security areas model estimates the amount of available, secure habitat where Grizzly Bears can forage for 24 to 48 hours without interacting with humans (Grizzly Bear Habitat Model Report, **Appendix 16-C4**). Within the model, security areas were defined as vegetated areas greater than 9 km^2 in size, below 1,900 m in elevation, and are greater than 500 m from human activity (>100 disturbance events per month; Grizzly Bear Habitat Model Report, **Appendix 16-C4**). The model considered direct disturbance footprints (unvegetated) in addition to ZOIs (500 m) around disturbance footprints. Two scenarios, existing baseline condition and post-Project condition, were computed using the model. The amount of security habitat in each condition was assessed within each of the 28 BMUs within the W-RAA.

Development associated with Project will alter 1.8% of secure Grizzly Bear habitat within the W-RAA (**Table 4.4-25**). With respect to the BMUs at baseline compared to post-Project, secure habitat loss may occur in 25 of the 28 units, with the greatest potential loss occurring in BMUs 10 and 9, at 8.1% and 5.2%, respectively.

Table 4.4-25 Change in Potential Effective Grizzly Bear Core Security Zone Habitat due to Project Effects by BMU

BMU	% of Secure Habitat: Baseline	% of Secure Habitat: Post-Project	% Change
1	85.0	84.1	-0.9
2	96.4	95.6	-0.8
3	93.5	93.3	-0.2
4	86.7	86.1	-0.6
5	94.0	93.8	-0.2
6	96.1	94.5	-1.6
7	91.2	86.2	-5.0
8	99.9	99.9	0.0
9	98.0	92.8	-5.2
10	95.0	86.9	-8.1
11	92.7	90.9	-1.8
12	90.8	89.3	-1.5
13	95.8	94.0	-1.8
14	93.5	89.8	-3.7
15	98.1	98.0	-0.1
16	100.0	100.0	0.0
17	99.9	99.9	0.0
18	93.7	91.2	-2.5
19	94.9	93.1	-1.8

BMU	% of Secure Habitat: Baseline	% of Secure Habitat: Post-Project	% Change
20	98.4	97.3	-1.1
21	95.6	94.0	-1.6
22	96.4	92.1	-4.3
23	98.1	97.1	-1.0
24	96.6	95.2	-1.4
25	95.8	95.2	-0.6
26	95.5	91.5	-4.0
27	99.5	99.4	-0.1
28	91.7	91.1	-0.6
TOTAL	**94.7**	**92.9**	**-1.8**

Denning Habitat — To assess the potential effects of the Project on Grizzly Bear denning habitat, direct and indirect effects were based on the amount of suitable denning habitat (High and Moderate-rated) within each of the 28 BMUs in the W-RAA. Habitat was modeled based on topographic features, ecosystem features, and elevation (Grizzly Bear Habitat Model Report, **Appendix 16-C4**). Project development has the potential to indirectly affect denning habitat due to sensory disturbance from the Project footprint to within 1 km of the Mine Site and the NAR. The ZOI used for indirect effects on habitat was developed based on background information, existing literature described above, and professional judgment.

There will be a direct loss of 2.8 km² (0.2%) of suitable Grizzly Bear denning habitat within the W-RAA to the Project footprint. The effect is mostly associated with the southern portion of the W-RAA, south of the Yukon River where there are more high elevation, mountainous areas. Reduced habitat effectiveness due to sensory disturbance will affect an additional 30.9 km² (2.4%) of suitable denning habitat within the W-RAA. With respect to the BMUs, suitable denning habitat may be lost in 11 of the 28 units, with the greatest potential loss occurring in BMUs 7 and 26, at 1.6% and 2.5%, respectively (**Table 4.4-26**).

Table 4.4-26 Area of Project Effects on Suitable Grizzly Bear Denning Habitat by BMU

BMU	Suitable Habitat (High and Moderate-High) within the W-RAA	Direct Habitat Loss		Reduced Habitat Effectiveness in the ZOI		Total Suitable Denning Habitat Altered	
	km²	km²	%	km²	%	km²	%
1	36.0	0.1	0.3	2.0	5.6	2.1	5.8
2	30.3	0.0	0.0	0.0	0.0	0.0	0.0
3	29.5	0.0	0.0	<0.1	<0.1	<0.1	<0.1
4	68.6	0.2	0.3	4.3	6.3	4.5	6.6
5	21.2	<0.1	<0.1	0.1	0.5	0.1	0.5
6	56.9	0.0	0.0	0.0	0.0	0.0	0.0
7	19.1	0.3	1.6	2.9	15.2	3.2	16.8
8	36.4	0.0	0.0	0.0	0.0	0.0	0.0
9	35.8	0.1	0.3	1.5	4.2	1.6	4.5
10	42.7	<0.1	<0.1	4.3	10.1	4.3	10.1
11	48.5	<0.1	<0.1	0.8	1.6	0.8	1.6
12	30.6	0.0	0.0	0.0	0.0	0.0	0.0
13	24.2	0.0	0.0	0.0	0.0	0.0	0.0
14	40.7	<0.1	<0.1	1.9	4.7	1.9	4.7
15	27.4	0.0	0.0	0.0	0.0	0.0	0.0
16	26.3	0.0	0.0	0.0	0.0	0.0	0.0
17	34.9	0.0	0.0	0.0	0.0	0.0	0.0
18	68.5	0.0	0.0	0.0	0.0	0.0	0.0
19	38.5	0.0	0.0	0.0	0.0	0.0	0.0
20	47.8	<0.1	<0.1	0.1	0.2	0.1	0.2
21	76.0	0.0	0.0	0.9	1.2	0.9	1.2
22	77.0	0.2	0.3	4.6	6.0	4.8	6.2
23	63.0	0.0	0.0	0.0	0.0	0.0	0.0
24	63.8	0.0	0.0	0.0	0.0	0.0	0.0
25	63.5	0.0	0.0	0.0	0.0	0.0	0.0
26	75.5	1.9	2.5	7.5	9.9	9.4	12.5
27	40.2	0.0	0.0	0.0	0.0	0.0	0.0
28	86.7	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**1,309.3**	**2.8**	**0.2**	**30.9**	**2.4**	**33.7**	**2.6**

There are no prescribed thresholds for Grizzly Bear habitat effectiveness, security habitat, or denning habitat.

- For habitat effectiveness, other jurisdictions in North America have adopted a threshold of 80% habitat effectiveness. Below this threshold, Grizzly Bear use of an area declines (Parks Canada 1997, as cited in AXYS 2001).
- For security habitat, a threshold of 65% within each BMU area is adopted. Jasper National Park adopted a minimum threshold for security areas of 60 to 67% secure within each BMU (H. Purves, pers. comm. as cited in AXYS 2001).
- For denning habitat, a habitat disturbance threshold of 15% was adopted, which is used as a general threshold for Project effects on Wildlife Habitat (**Section 4.4.1**).

Habitat Effectiveness (HE) — The Project will have a combined direct and indirect effect on 1% of the effective Grizzly Bear habitat in the W-RAA. All BMUs remain greater than 80% effective with the exception of BMUs 1, 4, and 7 (**Table 4.4-23** and **Table 4.4-24**) which were already below threshold levels at baseline conditions. Those BMUs have relatively high human activity due to their proximity to Dawson City and placer mining activity. Five BMUs would have no change in effective habitat from Project-related activities. Overall, both green-up and green-down habitat effectiveness in the post-Project condition is greater than 90% effective. Therefore, the change in effective habitat quality or quantity does not fall below the 80% threshold based on Project-related activities for the 28 BMUs within the W-RAA.

Security Habitat — The Project will have a combined direct and indirect effect on 1.8% of the security zone habitat in the W-RAA. Grizzly Bear security habitat in each BMU occurs above threshold levels ranging from 84.1% to 99.4%. Three BMUs (8, 16, and 17) will experience no change with respect to security habitat following Project development (**Table 4.4-25**).

Denning Habitat — The Project will have a direct effect on 0.2% and an indirect effect on 2.4% of the denning habitat in the W-RAA. The residual effect on suitable denning habitat does not exceed the 15% threshold. Within all BMUs, except BMU 7, denning habitat either directly or indirectly affected by the Project will be below threshold levels ranging from less than 0.1% to 2.5% for direct effects, and less than 0.1% to 10.1% for indirect effects (**Table 4.4-26**). Indirect effects in BMU 7 will occur in 15.2% of the BMU which slightly exceeds the 15% threshold for denning habitat.

Considering the three habitat loss and habitat effectiveness measures (HE, Security, Denning Habitat), the residual effects of the Project on Grizzly Bear habitat will be adverse in direction, low in magnitude, local in geographic extent, long-term in duration (but not permanent), and continuous. The residual effect is considered fully reversible after mine closure and site reclamation. The effect is likely because Grizzly Bear and suitable habitat are known to occur in the Project footprint and ZOI (**Table 4.4-27**). The context for Grizzly Bear is moderate. Grizzly Bear is a species of Special Concern; however, Grizzly Bears have large home ranges and Grizzly Bear density in the W-RAA is considered to be low, therefore the Project would affect a very small portion of an individual bear's range.

Table 4.4-27 Effect Characteristics Ratings for Grizzly Bear Habitat Effectiveness, Security and Denning

Residual Effect Characteristic	Definition	Rationale for Rating
Direction	Adverse	There will be a loss of potential effective habitat, security habitat and denning to the Project footprint.
Magnitude	Low	In general low amount of change expected in effective habitat relative to existing conditions in the W-RAA.
Geographic Extent	Local	Residual effects will be limited to the footprint and ZOI.
Timing	April to October	Time period where grizzly bears are not denning (denning occurs October–April).
Frequency	Continuous	Potential effective habitat will be continuously affected over the life of the Project.
Duration	Long-term	Occurs over the life of the Project (>20 years).
Reversibility	Fully Reversible	Habitat effects will be fully reversible with Reclamation and Closure.
Likelihood	Likely	Grizzly Bear and habitat are known to occur in the Project footprint and ZOI.

4.4.7.4 Summary of Project–related Residual Effects and Significance on Grizzly Bear

Potential residual adverse effects and proposed mitigation measures for Grizzly Bear are summarized in **Table 4.4-28**. Residual effects for Grizzly Bear include habitat loss due to the Project footprint and reduced habitat effectiveness due to sensory disturbance. Habitat was evaluated using effectiveness, security and denning models. Habitat loss is expected to occur only during the Construction phase, while reduced habitat effectiveness is expected to occur throughout all phases of the Project. The residual effects for Grizzly Bear were assessed as low in magnitude and below all identified thresholds for habitat effects, with the exception of indirect effects for one of the 28 BMUs in the W-RAA. The context for Grizzly Bear is moderate. Grizzly Bear is listed as a species of Special Concern (COSEWIC 2012), however, Grizzly Bears have large home ranges and Grizzly Bear density in the W-RAA is considered to be low, therefore the Project would affect a very small portion of an individual bear's range. Based on these considerations, residual effects on habitat were considered to be not significant and should not pose a risk to the long-term persistence of Grizzly Bear at the regional level (i.e., W-RAA). The level of confidence in these significance determinations was moderate due to knowledge of Grizzly Bears in the region based on literature and uncertainty in the level of activity that poses a threshold level of disturbance to Grizzly Bears.

Table 4.4-28 Summary of Residual Effects on Grizzly Bear

Residual Effects	Contributing Project Activities	Proposed Mitigation Measures	Residual Effects Characterization (see Notes for details)										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat Loss and Reduced Habitat Effectiveness	Footprint clearing (Construction) Sensory disturbances from the mine site and NAR (Construction, Operation, Reclamation and Closure)	• Project Design • Project Personnel Wildlife Awareness Orientation • Minimize Habitat Disturbance • Wildlife Protection Protocols • Manage Traffic • Manage Aircraft Operations	A	L	local	Y	L	C	F	L	M	NS	M

Residual Effects Characterization:

Direction: P = Positive, A = Adverse
Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent: Local = Project footprint or ZOI, RAA = Regional, T = Territorial
Timing: Seasonal: (W)inter or (S)ummer, Y= Year-round
Duration: S = Short Term, L = Long-term, P = Permanent
Frequency: I = Infrequent, F = Frequent, C = Continuous
Reversibility: F = Fully Reversible, P = Partially Reversible, I = Irreversible
Context: High = H, Moderate = M, L = Low
Likelihood: U = Unlikely, L = Likely
Significance: NS = Not-Significant, S = Significant
Level of Confidence: H = High, M = Moderate, L = Low

4.4.8 WOLVERINE SUBCOMPONENT

4.4.8.1 Potential Project-related Effects on Wolverine

Potential effects on Wolverine include habitat loss from the Project footprint, reduced habitat effectiveness due to sensory disturbances, mortality risk from increased human-wolverine encounters, and alteration to movement in response to Project infrastructure. Potential Project-related effects can occur year-round as Wolverine are year-round residents of the W-RAA, and can occur during the Construction, Operation, and Closure and Reclamation Phases.

4.4.8.2 Mitigation Measures for Wolverine

Mitigation measures that will be used to reduce or eliminate the potential Project-related effects on Wolverine include considerations in Project Design, Project Personnel Wildlife Awareness Orientation, Minimize Habitat Disturbance, Reduce Human-Wildlife Encounters, Wildlife Protection Protocols, Manage Traffic, and Manage Aircraft Operations — summaries of which are provided in **Section 4.3** and details in the WPP (**Appendix 31-F**). A key mitigation measure specific to Wolverine includes waste management practices to avoid attraction, and avoidance of denning sites. Following the successful implementation of these mitigation measures, habitat loss due to the Project footprint and reduced habitat effectiveness due to sensory disturbance are the residual effects expected to remain for Wolverine.

Mortality risk due to collisions with vehicles, and improved hunting access was not carried forward in the assessment of Project-related effects for Wolverine because of the low probability of morality risk due to the Project and the mitigation measures identified above are anticipated to be effective at eliminating Project-related sources of mortality for Wolverine. Remote camera studies on the NAR observed only three Wolverine during winter at Eureka Ridge and Sulphur Road camera locations in the northern portion of the NAR and few occurrences of Wolverine snow tracks observed along the NAR and Mine Site footprint during baseline surveys (Wildlife Field Program Report, **Appendix 16-D**), demonstrating the low interaction and thus low probability of Wolverine mortality risk due to vehicles. No Wolverine mortalities were reported out of 753 animals reported to be hit by motor vehicles on Yukon highways between 2003 and 2014, further demonstrating the low likelihood of vehicle-related mortalities for Wolverine in the region (EDI 2015). The primary access gained along the NAR will be in winter as the existing portions of the road below the Indian River are currently not maintained in winter. Although hunting of Wolverine is permitted in Yukon, it is only permitted from 1 August – 31 October and according to harvest management records from 2006–2015 no Wolverine were killed from hunting in GMZs 3 and 5, which overlap with the W-RAA (Environment Yukon 2016d).

In addition to hunting, Wolverine harvest by trapping is a regulated activity in Yukon that only occurs in winter (November 1 – March 10, Environment Yukon 2015a) and is limited to trappers that hold licenses and concessions in the areas that would overlap with the Project footprint. Therefore it is unlikely that trapping pressure would increase in any measureable way with the Project.

Alteration to movement due to Project infrastructure and activities was also not carried forward in the assessment of Project-related effects because of the current low occurrences of Wolverine interacting with the NAR (Wildlife Field Program Report, **Appendix 16-D**). Furthermore, Wolverine have relatively large home ranges and the increase in road density within the W-RAA due to the Project would be negligible. The effects of road density on Wolverine vary: some studies report Wolverine occurrence decreasing above a road density of 1.5 km/km² (Carroll et al. 2001; Scarfford and Boyce 2015), while other studies report Wolverine occurrence decreasing above a road density of 2.0 km/km² (Lofroth and Krebs 2007; Scarfford and Boyce 2015). Road density within the W-RAA will increase from 0.142 km/km² to 0.144 km/km² due to the Project, which is considerably less than the road densities mentioned in the studies above.

4.4.8.3 Residual Effects and Significance of Residual Effects on Wolverine

Project-related residual effects were assessed based on potential interactions (**Table 4.1-2**). Project-related residual effects on Wolverine were considered within the context of potential denning habitat within the W-RAA. Residual effects are habitat loss from the Project footprint and reduced habitat effectiveness due to Project-related sensory disturbance. This section first provides background information that details the residual effects and then presents the residual effects assessment and significance of residual effects.

Background Information

Wolverine are assumed to occupy landscapes across all of Yukon and are generally associated with undisturbed habitats in boreal forest, alpine, and high arctic tundra (Copeland et al. 2010). They are highly territorial and move extensively within their home ranges, which range in size from 139 to 526 km² in Yukon (Banci 1987). High Wolverine abundance generally occurs in areas with large populations of ungulates and good denning habitat (Lofroth and Krebs 2007), which is considered critical habitat (Copeland et al. 2010). Female Wolverine use two types of dens: natal and maternal (Magoun and Copeland 1998). Natal dens are used from early February to mid-March for parturition (i.e., birthing) and immediately post-partum (Copeland et al. 2010). When natal den conditions become unsuitable, females move kits to maternal dens, which can be several kilometres from natal den sites. Female Wolverine may use multiple maternal dens within a single year (Magoun and Copeland 1998). Wolverine dens have been almost exclusively reported above treeline in deep snowdrifts (i.e., >1 m, Magoun and Copeland 1998). Snow cover through the denning season has been suggested as a primary factor driving den site selection and a potential limitation to the distribution of Wolverine throughout their circumpolar range (Copeland et al. 2010).

The denning period (i.e., late winter to early spring) is considered the most sensitive time of the year for Wolverine (Heinmeyer and Copeland 1999, Heinemeyer et al. 2001). Krebs et al. (2007) found that heli-skiing and backcountry skiing were negatively associated with winter habitat use by female Wolverine. Wolverine typically select den sites away from areas of human disturbance (May et al. 2012). Copeland (1996) found that human disturbance at den sites resulted in den abandonment, but not kit abandonment. In southern Norway, May et al. (2012) observed minimum thresholds for den site selection at approximately

1.5 km for private roads and 7.5 km for public roads. In northwestern Alberta, Scrafford and Boyce (2014) located a den within 400 m of a winter road and within 2 to 3 km of major industrial roads. However, because dens are often found at high elevations and are hard to locate, it is difficult to predict the degree of disturbance on denning Wolverine.

Habitat Loss and Reduced Habitat Effectiveness

Habitat loss for Wolverine was assessed quantitatively by calculating the amount of potential denning habitat within the W-RAA that will be directly lost to the Project footprint. Reduced habitat effectiveness was quantified using a ZOI approach (**Section 2.0**). The ZOI defines the amount of potential denning habitat adjacent to the Project footprint that will experience reduced habitat effectiveness due to sensory disturbance. Two ZOI widths were determined for Wolverine based on background information, existing literature, and professional judgement: 5 km around the proposed Mine Site footprint and 1 km around the proposed NAR footprint. Habitat effects for Wolverine were assessed for total potential denning habitat (i.e., moderate- or high-rated) within the W-RAA based on a denning habitat model (Wolverine Denning Habitat Model Report, **Appendix 16-C5**). The denning habitat model is based on snow cover estimates from 2006–2015 and assumes high quality denning habitats are located within areas that are commonly or regularly snow covered during late spring. This model suggested that the W-RAA contains limited Wolverine denning habitat. In the absence of regulatory guidance for the establishment of quantitative thresholds of denning habitat loss for Wolverine, a 15% threshold for significance determinations was applied to habitat effects for Wolverine within the W-RAA (refer to **Section 4.4.1** for rationale regarding this threshold).

Wolverine are able to establish dens in suitable locations that are too small to be mapped (i.e., microsite snow cover is not detectable at the scale of the satellite imagery). Furthermore, Wolverine may select maternal den locations based on features within the habitat that are not remotely detectable or easily mapped at the landscape scale, such as under fallen trees or within boulder fields. Consequently, as a conservative approach, we have assumed that Wolverine dens could occur anywhere in the W-RAA with suitable snow depths (i.e., >1 m), however, it is unlikely that all mapped areas would have the appropriate microsite characteristics to support Wolverine dens.

Given this approach, the Project could directly affect 8.89 km² of potential denning habitat within the W-RAA, which represents 0.70% of potential denning habitat within the W-RAA (**Table 4.4-29**). An additional 99.24 km² of potential denning habitat within the ZOI could experience reduced habitat effectiveness, which represents 7.82% of potential denning habitat within the W-RAA. The combined residual effect of habitat loss and reduced habitat effectiveness could alter up to 8.52% of potential denning habitat within the W-RAA.

Table 4.4-29 Area of Potential Denning Habitat Loss and Reduced Habitat Effectiveness for Wolverine

Habitat Class	Total area in W-RAA	Habitat Loss		Reduced Habitat Effectiveness		Total Potential Denning Habitat Altered	
	km²	km²	%	km²	%	km²	%
High	22.77	0.00	0	0.64	2.83	0.64	2.83
Moderate	1246.23	8.89	0.71	98.60	7.91	107.49	8.63
Total Potential Denning Habitat	**1268.99**	**8.89**	**0.70**	**99.24**	**7.82**	**108.14**	**8.52**

The residual effects of habitat loss and reduced habitat effectiveness on Wolverine will be adverse in direction, low in magnitude, local in geographic extent, long-term in duration (but reversible), and continuous in frequency (**Table 4.4-30)**. The residual effects will be low in magnitude because the sum of habitat loss and reduced habitat effectiveness for potential denning habitat is estimated at 8.52% of the available potential denning habitat within the W-RAA (**Table 4.4-29**), which is less than the 10% threshold for low magnitude effects as defined in **Section 4.4.1**. The context for Wolverine was considered moderate as Wolverine are a species of 'special concern' by COSEWIC (2014), however, Yukon contains a high proportion of Canada's estimated Wolverine population and densities in Yukon are some of the highest reported in North America (**Section 3.3.6**).

Since the residual effects of habitat loss and reduced habitat effectiveness were assessed as low magnitude, the residual effects were considered not significant and should not pose a risk to the long-term persistence and viability of the Wolverine population at the regional level (i.e., W-RAA). The probability of the residual effects occurring was rated as likely because Wolverine and potential denning habitat occurs within the Project footprint and ZOI. The level of confidence in this significance determination is moderate in consideration of the limited spatial habitat mapping available at the regional level prior to the baseline studies conducted for this Project.

Table 4.4-30 Effect Characteristics Ratings for the Wolverine – Habitat Loss and Reduced Effectiveness

Residual Effect Characteristic	Definition	Rationale for Rating
Direction	Adverse	The alteration of potential denning habitat would be adverse.
Magnitude	Low	The alteration of potential denning habitat due to the Project footprint and sensory disturbance is 8.52% of the potential denning habitat within the W-RAA.
Geographic Extent	Local	Habitat loss would be limited to the Project footprint, and reduced habitat effectiveness would be limited to the ZOI.
Timing	Seasonal (winter)	Late winter to early spring.
Frequency	Continuous	Potential denning habitat would be affected over the life of the Project. Although the level of activity would change throughout the Project, residual effects would be continuous.
Duration	Long-term	Potential denning habitat would be affected over the life of the Project (i.e., >20 years).
Reversibility	Fully Reversible	Habitat effects would be fully reversible following Reclamation and Closure.
Likelihood	Likely	Wolverine and potential denning habitat are known to occur in the Project footprint and ZOI.

4.4.8.4 Summary of Project–Related Residual Effects and Significance of Residual Effects on Wolverine

Project-related residual effects and proposed mitigation measures for Wolverine are summarized in **Table 4.4-31**. Residual effects for Wolverine include habitat loss due to the Project footprint and reduced habitat effectiveness due to sensory disturbance. While habitat loss is expected to only occur during the Construction phase, reduced habitat effectiveness is expected to occur throughout all phases of the Project. The residual effects for Wolverine were assessed as low in magnitude due to the limited amount of habitat altered from the Project (8.52% of potential denning habitat in W-RAA). The context for Wolverine was considered moderate as Wolverine are a species of 'special concern' by COSEWIC (2014); however, Yukon contains a high proportion of Canada's estimated Wolverine population and densities in Yukon are some of the highest reported in North America. Based on these considerations, the residual effect on potential denning habitat for Wolverine was considered to be not significant and should not pose a risk to the long-term persistence and viability of the Wolverine population at the regional level (i.e., W-RAA). The level of confidence in this significance determination is moderate in consideration of the limited spatial habitat mapping available at the regional level prior to the baseline studies conducted for this Project.

Table 4.4-31 Summary of Potential Residual Adverse Effects on Wolverine

Potential Residual Adverse Effects	Contributing Project Activities	Proposed Mitigation Measures	Residual Effects Characterization (see Notes for details)										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat Loss And Reduced Habitat Effectiveness	Footprint clearing (Construction) Sensory disturbances (all Project phases)	• Project Design • Project Personnel Wildlife Awareness Orientation • Minimize Habitat Disturbance • Reduce Human-Wildlife Encounters • Wildlife Protection Protocols • Manage Traffic • Manage Aircraft Operations	A	L	Local	S	L	C	F	L	M	NS	M

Residual Effects Characterization:

Direction: P = Positive, A = Adverse
Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent: Local = Project footprint or ZOI, RAA = Regional, T = Territorial
Timing: Seasonal: (W)inter or (S)ummer, Y= Year-round
Duration: S = Short Term, L = Long-term, P = Permanent
Frequency: I = Infrequent, F = Frequent, C = Continuous
Reversibility: F = Fully Reversible, P = Partially Reversible, I = Irreversible
Context: High = H, Moderate = M, L = Low
Likelihood: U = Unlikely, L = Likely
Significance: NS = Not-Significant, S = Significant
Level of Confidence: H = High, M = Moderate, L = Low

4.4.9 Little Brown Myotis Subcomponent

4.4.9.1 Potential Project-Related Effects on Little Brown Myotis

Potential effects on Little Brown Myotis include habitat loss from the Project footprint, reduced habitat effectiveness due to sensory disturbances, and mortality risk from collisions with Project-related traffic. Potential Project-related effects can occur during the growing season when bats are expected to occur in the W-RAA, and can occur during the Construction, Operation, and Closure and Reclamation Phases.

4.4.9.2 Mitigation Measures for Little Brown Myotis

Mitigation measures that will be used to reduce or eliminate the potential Project-related effects on Little Brown Myotis include Project Design, Project Personnel Wildlife Awareness Orientation, Minimize Habitat Disturbance, Wildlife Protection Protocols, Manage Traffic, and Manage Aircraft Operations — summaries of which are provided in **Section 4.3** and details in the WPP (**Appendix 31-F**). Key mitigation measures specific to Little Brown Myotis include the following:

- Pre-clearing surveys for bat roosts will be conducted in habitats with high potential to support roosts prior to the commencement of construction activities.

- Any identified bat roosts will be left structurally intact and a no-disturbance buffer will be established around active roosts.

Following the successful implementation of these mitigation measures, residual effects are expected to remain for Little Brown Myotis related to direct habitat loss due to the Project footprint and reduced habitat effectiveness due to sensory disturbance. Mortality risk due to accidental destruction of roosts during the Construction phase was not carried forward in the assessment of Project-related effects for Little Brown Myotis because the mitigation measures identified above will effectively eliminate Project-related sources of bat mortality.

4.4.9.3 Residual Effects and Significance of Residual Effects on Little Brown Myotis

Project-related residual effects on Little Brown Myotis were assessed based on potential interactions (**Table 4.1-2**) and were considered within the context of potential roosting habitat within the W-RAA. Residual effects are habitat loss from the Project footprint and reduced habitat effectiveness due to Project-related sensory disturbance. This section first provides background information that details the residual effects and then presents the residual effects assessment and significance of residual effects.

Background Information

Roosting habitat in the summer is considered the limiting habitat for Little Brown Myotis that has most potential for interaction with the Project. Summer roosts provide shelter from predators and weather, and in some cases, protection for raising young (Nagorsen and Brigham 1993). To assess effects to potential roosting habitat, attributes that are known to contain suitable roosting habitat in other areas of Yukon were used to characterize potential roosting habitat in the W-RAA. For example, bat call surveys conducted in Yukon between April and September have confirmed the occurrence of Little Brown Myotis up to 1,000 m elevation within their range (Slough and Jung 2008). During the day, Little Brown Myotis roost in tree cavities, rock crevices, caves, and artificial structures, or under the bark of trees (Holroyd et al. 2016). Therefore, attributes that indicate old forest (i.e. > 130 years) below 1000 m elevation provide an approximation of habitat suitable to containing the features used by bats for roosting.

Habitat changes due to forest clearing practices that can adversely affect Little Brown Myotis include failure to recruit appropriately aged trees of the appropriate size and decay class for future roosting habitat (Maser et al. 1979; Holroyd et al. 2016). Windthrow is also generally higher along the edge of forest clearings, which can result in further loss of roosting habitat (Ruell 2000). Furthermore, sensory disturbances (e.g., noise, movement, dust) can result in additional loss of roosting habitat in areas adjacent to forest clearings (Holroyd and Craig 2016). Removal of forest cover may also reduce habitat suitability by causing a decline in insect populations, thereby reducing prey availability for bats and adversely impacting bat survival rates (Vonhof and Barclay 1997). Habitat loss and degradation may also disrupt drainage patterns, causing degradation or flooding of roost features (Holroyd and Craig 2016).

Indirect habitat effects also include habitat fragmentation, which can lead to increased access for predators that prey on roosting bats (Kalcounis and Brigham 1998; Holroyd and Craig 2016). Bats that roost along forest edges may experience higher predation risk compared to bats that roost in interior forests (Hutchinson and Lacki 2000). Jung et al. (1999) reported reduced activity of *Myotis* spp. in open-canopied stands and suggested it was due to increased predation risk (Holroyd et al. 2016).

Habitat Loss and Reduced Habitat Effectiveness

Habitat loss for Little Brown Myotis was assessed quantitatively by calculating the amount of potential roosting habitat within the W-RAA (i.e., old forest below 1,000 m elevation) that will be directly lost to the Project footprint. Reduced habitat effectiveness was quantified using a ZOI approach. The ZOI for Little Brown Myotis was defined as a 100 m buffer around the Project footprint and was based on the size of the core area buffer applied to identified bat roosts in British Columbia (Holroyd and Craig 2016), as well as existing literature and professional judgement. Noise and dust modeling performed for the Mine Site were assessed for their potential influence on potential roosting habitat. The highest modeled dust levels from the Mine Site are within 100 m from the Mine Site footprint and noise levels within 100 m from the Mine Site were well below noise levels that could potentially affect bat habitat (i.e. 150 dBa associated with blasting activities) indicated by Holroyd and Craig (2016) and were below 55 dBA levels which is the ambient noise from mining operations that is recommended by The Environment Code of Practice for Metal Mines (Environment Canada 2009) when assessing effects on wildlife. Although noise and dust modeling were not performed for the NAR, the noise and dust associated with activities on the NAR should not exceed those modeled for the Mine Site and should be encompassed within 100 m ZOI of the NAR footprint.

The Project could directly affect 0.59 km² of potential roosting habitat within the W-RAA and an additional 1.18 km² of potential roosting habitat within the ZOI could experience reduced habitat effectiveness, which represents 0.57% of the total potential roosting habitat within the W-RAA (**Table 4.4-32**).

Table 4.4-32 Loss and Reduced Effectiveness of Little Brown Myotis Potential Roosting Habitat

Habitat Type	Total Area of Potential Roosting Habitat in W-RAA	Habitat Loss		Reduced Habitat Effectiveness		Total Potential Roosting Habitat Altered	
	km²	km²	%	km²	%	km²	%
Potential Roosting Habitat (old forest below 1000 m	307.90	0.59	0.19	1.18	0.38	1.77	0.57

The W-RAA, ZOI, and Project footprint exclude areas above 1,000 m elevation. Area results assume even distribution of ecological communities for all ecosystem mapping polygons. This is a conservative approach to ensure no communities are excluded from the analysis. However, this approach could result in the overestimation of the area of communities within the W-RAA, ZOI and/or Project footprint.

Because the combined effects of habitat loss and reduced habitat effectiveness on potential roosting habitat are considered low magnitude (refer to **Section 4.4.1**) with only 0.57% of the potential roosting habitat available in the W-RAA affected by the Project, the residual effect is considered a low magnitude effect (**Table 4.4-32**).

The residual effects of habitat loss and reduced habitat effectiveness on Little Brown Myotis will be adverse in direction, low in magnitude, local in geographic extent, long-term in duration, and continuous in frequency. The residual effects are considered to be fully reversible following Reclamation and Closure. The probability of occurrence is likely given that some suitable roosting habitat may be cleared within the Project footprint; however, to date no bat roosts have been found within the Project footprint and pre-clearing surveys for bat roosts will be conducted in suitable habitats prior to construction (**Table 4.4-33**).

The context for Little Brown Myotis is moderate considering the current threat of White-nose Syndrome on bats and their Endangered SARA-listing; however, the disease is not believed to have expanded into Yukon bat populations yet (COSEWIC 2013). Based on these considerations, the residual effects were considered not significant and should not pose a risk to the long-term persistence and viability of the Little Brown Myotis population at the regional level (i.e., W-RAA). The level of confidence in the significance determination is moderate considering the course scale of the habitat mapping performed. However, the areas mapped are only potential roosting habitat and it is unlikely that all of the area mapped will contain the discrete habitat features (i.e. roost trees) to support roosting bats. Therefore potential roosting habitat is likely over-estimated, increasing our confidence in the assessment given this conservative approach.

Table 4.4-33 Effect Characteristics Ratings for Little Brown Myotis – Habitat Loss and Reduced Habitat Effectiveness

Residual Effect Characteristic	Definition	Rationale for Rating
Direction	Adverse	The loss or reduced effectiveness of potential roosting habitat would be adverse.
Magnitude	Low	The estimated loss and reduced effectiveness of potential roosting habitat due to the Project footprint and sensory disturbance is 0.57% of the potential roosting habitat in the W-RAA.
Geographic Extent	Local	Habitat loss would be limited to the Project footprint, and reduced habitat effectiveness would be limited to the ZOI.
Timing	Seasonal (summer)	Bats are typically present in Yukon from April to September.
Frequency	Continuous	Potential roosting habitat would be affected over the life of the Project. Although the level of activity would change throughout the Project, residual effects would be continuous.
Duration	Long-term	Potential roosting habitat would be affected over the life of the Project (i.e., 20 years).
Reversibility	Fully Reversible	Habitat effects would be fully reversible following Reclamation and Closure.
Likelihood	Likely	Little Brown Myotis are known to occur in the W-RAA and near the Project footprint, but the occurrence of roosts has not been confirmed.

4.4.9.4 Summary of Project–Related Residual Effects and Significance of Residual Effects on Little Brown Myotis

Project-related residual effects and proposed mitigation measures for Little Brown Myotis are summarized in **Table 4.4-9**. Residual effects for Little Brown Myotis include habitat loss due to the Project footprint and reduced habitat effectiveness due to sensory disturbance. While habitat loss is expected to only occur during the Construction phase, reduced habitat effectiveness is expected to occur throughout all phases of the Project. The residual effects for Little Brown Myotis were assessed as low in magnitude, due to the low proportion of potential roosting habitat affected by the Project (0.57%) compared to that available in the W-RAA. The context for Little Brown Myotis is moderate considering the current threat of White-nose Syndrome on bats and their Endangered SARA-listing; however, the disease is not believed to have expanded into Yukon bat populations yet (COSEWIC 2013). Based on these considerations, the residual effects are considered not significant (**Table 4.4-34**) and should not pose a risk to the long-term persistence and viability of the Little Brown Myotis population at the regional level. The level of confidence in the significance determination is moderate considering the coarse scale of the habitat mapping performed. However, the areas mapped are only potential roosting habitat and it is unlikely that all of the area mapped will contain the discrete habitat features (e.g., roost trees, rock crevices) to support roosting bats. Therefore potential roosting habitat is likely over-estimated, increasing confidence in the assessment given this conservative approach.

Table 4.4-34 Summary of Project-Related Residual Effects on Little Brown Myotis

Residual Effects	Contributing Project Activities	Proposed Mitigation Measures	Residual Effects Characterization (see Notes for details)										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat Loss and Reduced Habitat Effectiveness	Footprint clearing (Construction) Sensory disturbances (all Project phases)	• Project Design • Project Personnel Wildlife Awareness Orientation • Minimize Habitat Disturbance • Wildlife Protection Protocols • Manage Traffic	A	L	Local	**S**	L	C	F	L	M	NS	M

Residual Effects Characterization:

Direction: P = Positive, A = Adverse
Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent: Local = Project footprint or ZOI, RAA = Regional, T = Territorial
Timing: Seasonal: (W)inter or (S)ummer, Y= Year-round
Duration: S = Short Term, L = Long-term, P = Permanent
Frequency: I = Infrequent, F = Frequent, C = Continuous
Reversibility: F = Fully Reversible, P = Partially Reversible, I = Irreversible
Context: High = H, Moderate = M, L = Low
Likelihood: U = Unlikely, L = Likely
Significance: NS = Not-Significant, S = Significant
Level of Confidence: H = High, M = Moderate, L = Low

4.5 SUBJECTS OF NOTE

4.5.1 MINERAL LICKS

Mineral licks are important to wildlife, particularly ungulates like Moose, Sheep, and goats because they provide a means to obtain essential mineral nutrients which otherwise may be lacking in an ungulate diet (Rea et al. 2004). Mineral licks can be characterized as 'wet' or 'dry' depending on their location and characteristics. Wet licks are found in moist, muddy areas and are typically used by moose. They are often characterized by a concentration of trails and tracks leading to a wet, muddy spring (Rea et al. 2004). Sheep and goats more commonly use dry licks which can be areas of exposed mineral soils on a hillside or cut bank.

During the Project baseline data collection program, four known or suspected mineral licks were reported to the Project team by Environment Yukon and local First Nations. Of the four reported mineral licks, three were potentially located in close proximity to the Project footprint (i.e., within 3 km), the Coffee Creek area, the Barker Creek valley, and the Maisy May Creek valley. Several field surveys were conducted by qualified biologists to locate the reported mineral licks. To date no mineral licks have been confirmed in or near the Project footprint despite substantial survey effort, although follow-up discussion and/or field surveys are planned for one of the reported licks (Wildlife Baseline Report, **Appendix 16-A**).

Reports of a mineral lick in the Coffee Creek area were provided to EDI by both Environment Yukon and TH, although neither could provide a specific location (i.e., geographic coordinates) and descriptions of the site varied. EDI biologists and the Proponent Environmental Monitors searched several areas within the Coffee Creek valley which matched the descriptions provided, but no mineral licks were located. However, biologists did note an abundance of Moose sign throughout the Coffee Creek valley and the surveys did locate several wildlife trails through the area. Given the volume of wildlife sign, biologists could not rule out the possibility of a mineral lick somewhere in the Coffee Creek area; therefore follow-up surveys focussed on searching the area along the proposed winter road through the Coffee Creek valley. No mineral licks were detected leading biologists to conclude that, if a mineral lick does occur in the Coffee Creek area, that it will not be affected by proposed Project infrastructure.

The reported mineral lick in the Barker Creek valley is part of a WKA identified by Environment Yukon (2016). EDI biologists conducted a thorough search of the location provided by Environment Yukon and walked the entire length of the proposed NAR that passes through the WKA. No evidence of a mineral lick was found. Biologists also noted a lack of other wildlife sign that might indicate a mineral lick in the vicinity (e.g., wildlife trails, extensive ungulate sign).

A mineral lick in the Maisy May valley was reported by TH during the Project consultation and engagement process. A detailed description of the mineral lick and its location was provided by the TH Fish and Wildlife Branch in the spring of 2016 (Ayoub, Pers. Comm. 2016). EDI biologists searched the area; however, to date no mineral lick has been located. Follow-up discussion and/or field surveys with the TH to confirm the exact location and status of the reported lick are pending.

If a mineral lick is found in the vicinity of the Project footprint, a number of mitigation measures identified in **Section 4.3** will apply. The baseline surveys described above were conducted to information Project siting, a component of the Project design mitigation. If licks were positively identified, their location would have been considered and avoided in siting infrastructure and laydown areas. If licks are identified during construction, and if Project design allows, that same practice will continue forward. If licks are located in the vicinity of the Project footprint, measures to Minimize Habitat Disturbance, Reduce Human-Wildlife Encounter Risks, and Wildlife Protection Protocols should be sufficient to allow continued wildlife use of mineral licks.

4.5.2 PREDATOR/PREY DYNAMICS

The term 'facilitated predation' is used to describe the idea that the Project could result, indirectly, in elevated predation rates on local ungulate populations by natural predators — primarily wolves. The primary Project component that could create this effect, as identified by Environment Yukon and the THTWG, is the year-round maintenance and operation of the NAR. Indirect mortality risk to ungulates associated with predation risk was not considered in the mortality effects assessments for each subcomponent because information is not available to quantify the Project's effects on predator-prey dynamics. The purpose of this section is to provide a synopsis of relevant literature on the subject and to conduct a qualitative evaluation of the potential for facilitated predation to occur considering the distribution of wolves and ungulates relative to the NAR.

There is evidence that, under certain conditions, wolves will select roads and other types of linear features (Whittington et al. 2005; Zimmerman et al. 2014), that wolves travel faster and farther along roads than through natural landscapes (Musiani et al 1998; Zimmerman et al 2014), that changes in distribution of wolves can be associated with movements along linear features (Latham 2009), that encounter rates with prey (Caribou) can be elevated near roads (Whittington et al. 2011), and that mortality sites of Caribou caused by wolves occur closer to linear features (James and Stuart-Smith 2000). However, relationships for most factors are varied, can have complex interactions, and are study specific (Latham and Boutin 2015).

At the individual and pack level, wolves display a high level of adaptability and variation in response to roads, other types of human modifications to the landscape, and to human activities (Guarie et al. 2011). Frequently, results among studies are contradictory. For example, Zimmerman et al (2014) observed increasing use of roads by wolves with road density, while Houle et al. (2010) observed decreasing use with density. Key factors that affect use of roads by wolves include level of human activity (notably traffic volumes), road density, prey availability and behaviour, and comparative ease of traveling through natural habitats (Whittington et al. 2004; Whittington et al. 2005; Zimmerman 2014). During winter, use of linear features by wolves can be highly dependent on whether or not the snow is packed by anthropogenic use (Paquet et al. 2010).

Wolves have the potential to exhibit both numerical and functional effects, in relation to movements along roads and other linear features, which can result in elevated predation on ungulates. Numerical effects refer to a change in predation due to a change in wolf densities (i.e. the number of kills per wolf is static). Numerical effects can result from a change in wolf distribution and from a change in wolf population size over time. Functional effects refer to an increase in predation due to an increase in the number of kills per wolf. Roads and other linear features can cause a numerical effect by facilitating movements that result in changes in wolf distributions and densities within a region (Latham et al. 2011).

4.5.2.1 Potential Effects of Facilitated Predation by Wolves on Ungulates in the Project Area

Based on the complexity of relationships among wolves, ungulate prey, and roads, it is impossible to identify the potential effects of facilitated predation associated with the NAR with confidence. The following inferences are supported by consistent patterns of responses in the literature, knowledge of wolves and ungulates in the Project's RAA, and conditions associated with the proposed NAR:

1. Conditions associated with the NAR are likely to be favourable for use by wolves. These conditions include low traffic volumes (Whittington et al 2005; Zimmerman et al. 2014) and regular plowing during the winter (Paquet et al. 2010).
2. Currently, wolves are known to occur along the length of the existing sections of the NAR. Therefore, movements of wolves along the NAR will not result in an expansion of their existing range.
3. Factors associated with the NAR and other Project effects will not result in widespread changes in habitat conditions that will affect the distribution of ungulate species, or introduce alternate prey. For example, expansion of wolf distribution into Caribou range in northern Alberta has been associated with the concurrent development of linear features and the creation of early seral habitats by forestry and oil and gas developments, which supported increased numbers and distribution of white-tailed deer (Latham et al. 2011). For the general Project area, neither Project effects nor reasonably foreseeable cumulative effects will result in widespread habitat changes that will affect prey numbers and distribution.
4. Potential effects of elevated predation risk along the NAR are likely to be limited to a relatively small extent surrounding the road (James and Stuart-Smith 2000), which limit the magnitude of any potential effects on ungulates at the population level. Local effects may also be minimized by the ability of ungulates to perceive any change in predation risk and avoid areas along the road (Dyer et al. 2001).

Species-Specific Effects

The ranges of three ungulate species overlap with the NAR: Caribou (Fortymile Caribou), Moose, and Thinhorn Sheep. A qualitative assessment of the potential for facilitated predation to occur for each species is presented below, based on the factors discussed above and the overlap of the road with known or predicted habitat or range of the species.

Based on recent telemetry data, the FC-RAA encompasses the southeastern-most winter range of the Fortymile Caribou herd[1]. The majority of used locations occurred west of the Yukon and White rivers; however, a proportion of use also occurred east of the rivers, within the FC-RAA. Two areas of use that overlapped with the NAR occurred within the RSA[2]. The area of highest use is along a band of alpine and subalpine areas running from Mount Stewart to Thistle Mountain to Mount Selwyn, north of the Yukon River. A broader area of low use encompassed the western half of the RSA between the Stewart River and Dawson and overlapped the NAR within the Maisy May Creek watershed. The density of wolves in those two areas is unknown; however, snow tracking and camera monitoring indicates that wolves are distributed widely along the NAR, including the two Caribou use areas (Wildlife Field Program Report, **Appendix 16-D**). Based on the available information, the primary potential mechanism of facilitated predation would be a functional effect of elevated travel rates by wolves along the road that could result in elevated encounter rates with Caribou. Fundamental changes in the distribution and dynamics of Caribou, wolves and alternative prey (Moose) due to the NAR are unlikely because the distribution of the three species appear to already overlap[3]. The degree to which predation rates along the road may be elevated, if at all, is impossible to identify due to the complexity of factors involved. The potential magnitude of the effect on Fortymile Caribou at the population level is likely to be low, based on the overlap of the ZOI of the NAR relative to the total area used by Caribou within the FC-RAA (Wildlife Baseline Report, **Appendix 16-A**).

The potential effect of facilitated predation by wolves on Moose is expected to be similar to Caribou. The primary mechanism of facilitated predation would be elevated travel rates by wolves along the road and, possibly, elevated encounter rates with Moose. Fundamental changes in the distribution and dynamics of Moose, wolves and alternative prey (Caribou) due to the NAR are unlikely because the distribution of the three species already overlap. The potential magnitude of the effect on Moose at the population level is likely to be low, based on the overlap of the ZOI of the road relative to the total area used by Moose within the W-RAA (Wildlife Baseline Report, **Appendix 16-A**).

1 Historically the Fortymile Caribou herd ranged much farther to the south and west.
2 The distribution and density of Caribou tend to vary over time, so patterns of overlap with the NAR may change.
3 Spatial separation from Moose has been hypothesized as a predator avoidance strategy by Caribou (Farnell et al. 1994; James et al. 2004)

Thinhorn Sheep occur in low numbers at three occurrence areas along the Yukon River. Occurrence areas are characterized by steep, non-forested, south aspect hillslopes with rock bluff complexes, along the north side of the Yukon River. The NAR runs in proximity (100–500 m) to the Ballarat occurrence area for approximately 3 km. If Sheep occasionally cross the road as part of movements among occurrence areas there is a chance they may experience higher predation risk if wolves are using the road for travel or hunting. However, based on the lack of evidence of travel by Sheep across the road (lack of sign from ground surveys and lack of movements captured by remote cameras on trails (Wildlife Field Program Report, **Appendix 16-D**) that risk is likely to be very low.

4.5.3 Disturbance to Moose in Post-rut Congregations

In Yukon, Moose are known to congregate in relatively high densities after the rut (Cooley et al. 2012, O'Donoghue et al. 2013). Locally, Moose are known to congregate from late October to December and occasionally into January depending on snow load. During this time, they tend to be concentrated in subalpine areas along higher ridges, generally in areas dominated by willow (*Salix* spp.). Analysis of early winter survey data identified several such congregation areas in the RAA. Those with the potential to interact with the proposed Project infrastructure are limited to a couple of sites along the NAR, in the King Solomon Dome area, and the Henderson Dome area (**Figure 2-10**, Wildlife Baseline Report, **Appendix 16-A**). As a result of Moose both being in high densities and relatively poor condition during the post-rut, there could be a further potential for increased mortality risk to Moose in these areas through disturbance and potential collisions associated with road traffic.

Human disturbances can generate behavioural responses analogous to exposure to predation risk, resulting in similar behavioural changes and energetic costs (Frid and Dill 2002). Predation risk can affect animals directly through increased energetic costs and indirectly through behaviour responses such as changing their spatial organization (Brown and Kottler 2007). Disturbances can also cause stress from experiencing fear that may affect physiological parameters (Creel et al. 2002). Moose in Sweden increased their movement 33-fold for the first hour following disturbance by backcountry skiers, resulting in an almost doubling of energetic usage per kilogram of body weight (Neumann et al. 2009).

The post-rut congregation period for Moose in this region (late-October to December) largely overlaps the period when the NAR will be closed for fall freeze-up. This overlap with planned road closure will mostly eliminate any potential interaction for Project effects for moose using these congregation areas. Mitigation measures related to traffic management (**Section 4.3.6**) are anticipated to eliminate any remaining potential for residual effects on post-rut congregations of Moose. These measures include:

- Road construction activities will be timed to avoid Moose congregation areas during the post-rut; if construction activities must occur during this time, additional monitoring and/or mitigation will be implemented.
- Road signage, both permanent and temporary, will be erected to inform users regarding seasonal wildlife issues along the NAR and site roads as necessary.

- Speed limits will be posted along the road, including additional speed restrictions for the protection of wildlife along specific sections of road and/or during specific seasons.
- The maximum speed limit along all Project roads will be 50 km/h, and speeds may be monitored by on-board GPS reporting. Reduced speeds are a proven method of reducing the potential for wildlife/vehicle collisions (EDI 2015).
- To reduce the potential for vehicle-wildlife collisions and disturbance to moose in post-rut areas, speed restrictions, temporary road closures and/or traffic restrictions (could be implemented as determined to be required.

5.0 ASSESSMENT OF CUMULATIVE EFFECTS

This section presents an assessment of potential cumulative effects on Wildlife and Wildlife Habitat. Cumulative effects result from interactions between Project-related residual effects and the incremental residual effects on Wildlife and Wildlife Habitat from other past, present and reasonably foreseeable future projects and activities. The full Project and Activity Inclusion List for this cumulative effects assessment (CEA) is provided in the Project Proposal (**Section 5.0 Assessment Methodology**, **Appendix 5-B**).

The anticipated residual cumulative effects on Wildlife and Wildlife Habitat are those that may remain after implementation of technically sound and feasible mitigation measures. The anticipated residual cumulative effects are described using the effects characteristics identified in **Table 5.1-1**. The determination of significance for the anticipated residual cumulative effects on Wildlife and Wildlife Habitat is based on a consideration of the residual effects characteristics and environmental context of Wildlife and Wildlife Habitat as presented in **Section 3.0.** The following sequence describes the approach to cumulative effects assessment for Wildlife and Wildlife Habitat:

- Assess type of project/activity and location of project/activity overlaid with the Cumulative Effects Assessment Area (equivalent and hereafter referred to as the RAA) for each subcomponent.
- Determine which projects/activities will have an interaction with the Project based on set criteria.
- Use assumptions of spatial boundaries based on project/activity category.
- Proceed with CEA consistent with methods used for each subcomponent in **Section 4.4.**
- Characterize potential residual cumulative effects and determine significance as defined in **Section 2.0** and as carried out for residual effects assessment in **Section 4.4.**

5.1 PROJECT-RELATED RESIDUAL EFFECTS

A list of Project-related residual effects on Wildlife and Wildlife Habitat, and rationales for their inclusion in (or exclusion from) the CEA, is provided in **Table 5.1-1**. If an interaction resulted in no effect or a negligible effect, it was not carried forward beyond **Section 4.1**. If a potential effect was identified as not residual in **Section 4.0**, it was also not carried forward to the cumulative effects assessment.

The Project-related residual adverse effects evaluated in the CEA are listed below:

- Habitat loss — all subcomponents
- Reduced habitat effectiveness — all subcomponents
- Mortality risk — Fortymile Caribou, Moose
- Alteration of movement — Fortymile Caribou, Thinhorn Sheep.

Table 5.1-1 Project-Related Residual Effects Considered in the Cumulative Effects Assessment

Project-related Residual Effect	Included in Cumulative Effects Assessment	Rationale
Fortymile Caribou		
Habitat Loss and Reduced Habitat Effectiveness	Yes	Combined habitat loss and reduced habitat effectiveness from multiple projects and activities could have an adverse cumulative effect on Fortymile caribou habitat.
Alteration of Movement	Yes	Barriers or filters to movement from multiple projects and activities could have an adverse cumulative effect on migration patterns of Fortymile caribou.
Mortality Risk	Yes	Combined vehicle traffic along roads from multiple projects and activities could increase mortality risk for Fortymile caribou due to collisions.
Klaza Caribou		
Habitat Loss and Reduced Habitat Effectiveness	Yes	Combined habitat loss and reduced habitat effectiveness from multiple projects and activities could have an adverse cumulative effect on Klaza caribou habitat.
Moose		
Habitat Loss and Reduced Habitat Effectiveness	Yes	Combined habitat loss and reduced habitat effectiveness from multiple projects and activities could have an adverse cumulative effect on Moose.
Mortality Risk	Yes	Combined vehicle traffic along roads from multiple projects and activities could increase mortality risk for Moose due to collisions.
Thinhorn Sheep		
Habitat Loss and Reduced Habitat Effectiveness	Yes	Combined habitat loss and reduced habitat effectiveness from multiple projects and activities could have an adverse cumulative effect on Thinhorn Sheep.
Alteration of Movement	Yes	There are three Sheep occurrence areas within the RAA; Sheep are expected to migrate between these areas in order to maintain viable sub-populations. Barriers to Sheep movement from multiple projects and activities could have an adverse cumulative effect on continued occupancy of Thinhorn Sheep occurrence areas within the RAA.
Grizzly Bear		
Habitat Loss and Reduced Habitat Effectiveness	Yes	Combined habitat loss and reduced habitat effectiveness from multiple projects and activities could have an adverse cumulative effect on Grizzly Bear.
Wolverine		
Habitat Loss and Reduced Habitat Effectiveness	Yes	Combined habitat loss and reduced habitat effectiveness from multiple projects and activities could have an adverse cumulative effect on Wolverine.
Little Brown Myotis		
Habitat Loss and Reduced Habitat Effectiveness	Yes	Combined habitat loss and reduced habitat effectiveness from multiple projects and activities could have an adverse cumulative effect on Little Brown Myotis.

5.2 SPATIAL AND TEMPORAL SCOPE OF THE CUMULATIVE EFFECTS ASSESSMENT

The spatial boundaries of the CEA for wildlife and wildlife habitat are the RAAs as described in **Section 1.3.1** and **Table 1.3-1**. A description of each RAA and supporting rationale for selection of those RAA boundaries is described in **Section 1.3.1**. The Wildlife RAAs are as follows:

- The Wildlife RAA (W-RAA; 13,661 km^2) is the area used to characterize Project and cumulative effects on Moose, Grizzly Bear, Wolverine, and Little Brown Myotis. The W-RAA was established based on the RSA that was used for large mammal studies and habitat modelling completed as part of the Project's wildlife baseline program.
- The Fortymile Caribou RAA (FC-RAA; 77,532 km^2), Klaza Caribou RAA (KC-RAA; 10,819 km^2) and Thinhorn Sheep RAA (TS-RAA; 5,263 km^2) are based on the local distribution of each of the species or herds.

The temporal boundaries of the CEA for Wildlife and Wildlife Habitat are the same as those described in **Section 1.3.2**. The temporal characteristics of the Project's Construction, Operation, Closure and Reclamation, and Post-closure phases are described in the Project Proposal.

5.3 OTHER PROJECTS AND ACTIVITIES

Other relevant projects and activities within the spatial and temporal scope of the CEA that have resulted or may result in residual adverse effects to Wildlife and Wildlife Habitat that could interact with the Project-related residual effects are identified in **Table 5.3-1**. An overview description of each of these projects and activities is provided, along with their relevant potential residual effects on Wildlife and Wildlife Habitat. Relevant projects and activities were identified from the Project and Activity Inclusion List in the Project Proposal (**Section 5.0 Assessment Methodology, Appendix 5-B**). Because four different RAA areas were used for assessing Wildlife and Wildlife Habitat subcomponents, this table includes a separate section for each RAA.

The following definitions were used to classify the status of projects and activities that could interact with the Project:

- Past – projects and land use activities that occurred in the past and are no longer active
- Present – existing and active projects and land use activities; all projects or land use activities that applied for approval or permitting prior to 2015 are assumed to be present projects or land use activities
- Future – reasonably foreseeable future projects or land use activities for which proposals have been submitted to YESAA (subsection 50(1)), or have entered into a formal approval or permitting process; applications submitted in 2015 and 2016 are assumed to be future projects or land use activities

Mineral exploration and placer mining projects have occurred in, and are likely to continue to occur in, the Project region. Although the claim blocks can be very extensive and numerous, actual works are likely to be limited to a few focal areas for either a short period of time, or seasonally for many years, as is the case for several quartz claims in the area. Projects and activities in each category summarized in **Table 5.3-1** were assessed in relation to the type of disturbance and potential interaction with each subcomponent. The overlap with existing disturbance was assessed, because an existing disturbance layer was used in the CEA that encompasses current disturbance from the full range of activity categories.

Table 5.3-1 Potential Residual Adverse Effects of Other Projects and Activities on Wildlife and Wildlife Habitat Subcomponents

Other Project / Activity	Status	Description	Potential Residual Effects	Number of Projects by RAA			
				Wildlife RAA[1]	Fortymile Caribou RAA	Klaza Caribou RAA	Thinhorn Sheep RAA
Quartz Exploration	Present	Multiple quartz projects are currently in exploration within the wildlife RAAs. Exploration for these permits is likely to continue either continuously or intermittently throughout the life of the Coffee Creek Project. Although the claim blocks can be very extensive and numerous, actual works are likely to be limited in extent to a few focal areas for either a short period of time, or seasonally for many years.	Habitat loss Reduced habitat effectiveness	38	111	32	23
Quartz Mine	Past	There are two past quartz projects in the closure and reclamation stages, Clinton Creek and Mt Nansen**,** within the wildlife RAAs**.**	Habitat loss	0	2 (All)	1 (Mt Nansen)	0
Quartz Mine	Present	There are two existing quartz projects in the operation stage, Brewery Creek (care and maintenance) and Minto (active)**,** within the wildlife RAAs. These quartz mining projects are likely to have similar residual effects as the Coffee Creek Project, which are described in **Section 4.0** above.	Habitat loss Reduced habitat effectiveness Alteration to movement Mortality risk	0	2 (All)	0	1 (Minto)
Quartz Mine	Future	Five quartz projects within the wildlife RAAs are considered as foreseeable future mines during the lifetime of the Coffee Creek Project. These projects are Casino, Revenue, Hoochekoo, Carmacks Copper, and Lonestar. Exploration for these projects is the advance stage. These projects are most likely to proceed to construction or operation phases during the next 20 years.	Habitat loss Reduced habitat effectiveness Alteration to movement Mortality risk	2 (Casino, Lonestar)	5 (All)	2 (Revenue, Casino)	2 (Casino, Carmacks)

Other Project / Activity	Status	Description	Potential Residual Effects	Number of Projects by RAA			
				Wildlife RAA[1]	Fortymile Caribou RAA	Klaza Caribou RAA	Thinhorn Sheep RAA
Placer	Present and future	Multiple current, future, and past placer projects overlap the wildlife RAAs. Exploration for these permits is likely to continue either continuously or intermittently throughout the life of the Project. Although the claim blocks can be extensive and numerous, actual works are likely to be limited in extent to a few focal areas for either a short period of time, or seasonally for many years.	Habitat loss Reduced habitat effectiveness	259	392	43	16
Industrial	Present	Four industrial projects overlap the wildlife RAAs. Project activities include upgrading fuel storage tanks at Little Gold Border Crossing on the Top of the World Highway, establishing a biomass boiler facility for the Dawson City waste water treatment plant, developing a quarry resource at Km 674.5 of the Klondike Highway, and developing a new material source at Km 62.5 of the Top of the World Highway.	Habitat loss	1	4	0	0
Industrial	Future	Continued operation of the Mackenzie Bulk Fuel and Card Lock in Dawson City. Additional activities of storing /selling lubricants and compressed gases, delivering home heating fuel.	Reduced habitat effectiveness (but overlaps Dawson ZOI)	0	1	0	0
Utilities	Present	Five utilities projects overlap the wildlife RAAs. Project activities include the continued operation of the water supply system in Dawson City, the establishment of a waste water treatment plant in Dawson City, the construction of an 80 m access road and transmission line at the Dawson City Airport, upgrades to the water supply and treatment equipment at the Rock Creek Community Supply near Dawson City, and the construction of a 400 km fibre optic interconnect system between Carmacks and Dawson City along the Klondike Highway ROW, with an additional extension to Mayo from Stewart Crossing along the Sliver Trail Highway ROW.	Habitat loss Reduced habitat effectiveness (but overlapping ZOI)	2	5	0	0

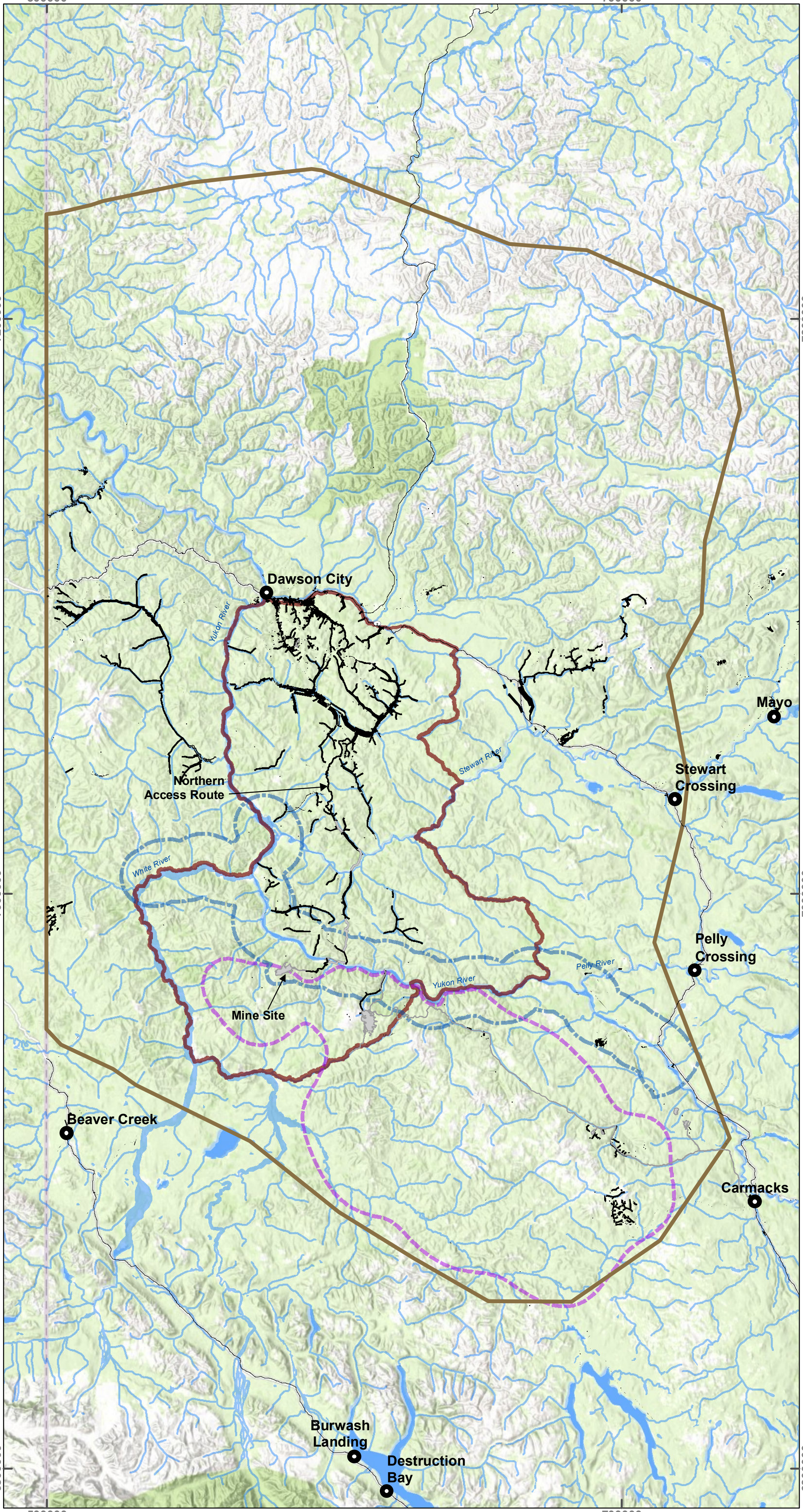
Other Project / Activity	Status	Description	Potential Residual Effects	Number of Projects by RAA			
				Wildlife RAA[1]	Fortymile Caribou RAA	Klaza Caribou RAA	Thinhorn Sheep RAA
Utilities	Future	Complete upgrades to existing force main infrastructure in Dawson City, which conveys treated effluent from the wastewater treatment plant to the Yukon River.	Reduced habitat effectiveness (but overlapping ZOI of Dawson)	0	1	0	0
Energy	Present	Multiple energy projects are currently operating within the wildlife RAAs. Project activities include two air emission permit renewals (i.e., Minto Mine and Dawson City), two transmission line upgrade projects (i.e., Dome subdivision in Dawson City and Stewart Crossing substation), and one temporary transmission line relocation project near Flat Creek along the Klondike Highway. Seven transmission line construction projects are also currently operating within the RAA including three small-scale residential projects (i.e., Dawson City and Stewart Crossing), one small-scale project at the Dawson City Airport, and three larger-scale projects situated between Carmacks / Stewart Crossing along the Klondike Highway, including a spur line to Minto Mine.	Habitat loss Alteration of movement Mortality Risk	1	12	0	4
Transportation	Present	Multiple projects currently operating within the wildlife RAAs. Activities include three culvert replacements on the Klondike Highway, one bridge rehabilitation on the Mount Nansen Road, road repairs near Dawson City, maintenance on existing Yukon River ferry ramps in Dawson City, and road realignments and/or works on riverbank protection along the Dempster and Klondike highways. Also underway: road and/or bridge construction to access several quartz/placer claims, a traditional fish camp near Minto Landing, and a transmission line ROW near Stewart Crossing, site preparation for a highway access on the Klondike Highway near Dawson City and a commercial fuelwood timber harvesting project near Minto Landing.	Reduced habitat effectiveness (but accounted for in existing road/highway ZOI)	2	16	0	1

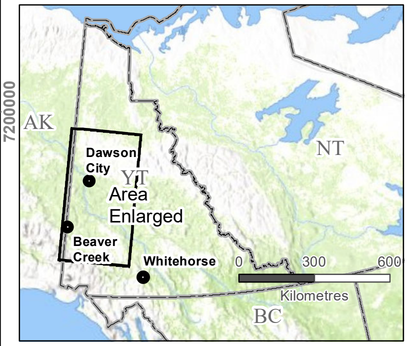
Other Project / Activity	Status	Description	Potential Residual Effects	Number of Projects by RAA			
				Wildlife RAA[1]	Fortymile Caribou RAA	Klaza Caribou RAA	Thinhorn Sheep RAA
Forestry	Past	Five past forestry projects have occurred in the past within the Bonanza Creek, Bruin Creek, Flat Creek, and North Klondike River watersheds. Project activities included road construction and upgrades, fuel wood harvesting, salvage logging, road de-commissioning, and restoration.	Habitat loss	3	5	0	0
Agriculture	Present	Eight agriculture activities are currently operating within the wildlife RAAs. Activities include horse ranching, cattle and/or hay production, crop irrigation, and organic produce or birch syrup production. All agriculture activities are located within relatively close proximity to the Klondike Highway.	Habitat loss	1	8	0	2
Settlements	Present	Dawson City and Pelly Crossing are two existing communities that overlap, or are adjacent to, wildlife RAAs. Additionally there are multiple settlement projects which overlap the wildlife RAAs. All settlement activities are located within relatively close proximity to Dawson City or the Top of the World, Klondike, and Dempster highways.	Habitat loss Reduced habitat effectiveness Alteration to movement	5	42	0	2
Existing Road network	Present	There is a network of existing roads that overlaps all wildlife RAAs. Paved roads are limited to portions of the Top of the World, Klondike, and Dempster highways and areas within Dawson City. Most roads within the wildlife RAAs are unpaved; some are accessible year-round, while others are seasonally accessible during the summer. The number of kilometres of each road type within each Wildlife RAA are summarized here.	Depending on road type: Habitat loss Seasonal: Reduced habitat effectiveness Mortality risk Alteration to movement	Paved: 26.6 km Unpaved all-season: 357.2 km Unpaved seasonal: 579.6 km	Paved: 322.1 km Unpaved all-season: 1082.0 km Unpaved seasonal: 1,109 km	Paved: 0.0 km Unpaved all-season: 198.8 km Unpaved seasonal: 125.8 km	Paved: 26.6 km Unpaved all-season: 97.7 km Unpaved seasonal: 113.4 km
Trapping and Hunting	Present	Multiple Trapline Concession Areas and nine Guide Outfitter Concession Areas overlap with the RAA. Activity occurs seasonally.	Mortality risk	Yes	Yes	Yes	Yes

1 Wildlife RAA includes Moose, Grizzly Bear, Wolverine and Little Brown Myotis.

COFFEE GOLD MINE

Disturbances Considered in the Cumulative Effects Assessment for Wildlife and Wildlife Habitat





Legend

- City/Town
- Fortymile Caribou Regional Assessment Area (FC-RAA)
- Thinhorn Sheep Regional Assessment Area (TS-RAA)
- Klaza Caribou Regional Assessment Area (KC-RAA)
- Wildlife Regional Assessment Area (W-RAA)
- Future Disturbance
- Existing Disturbance
- Project Footprint

Notes

1. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

1. Sources: Esri, HERE, DeLorme, increment P Corp., NPS, NRCan, Ordnance Survey, © OpenStreetMap contributors, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community
2. Fortymile caribou herd study area adapted by data provided by Yukon Government (further developed by EDI Environmental Dynamics Inc.
3. Disturbance Data provided by Yukon Government (2015).
4. Project footrpint provided by Goldcorp Inc. (2017).

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Figure 5.3-1	Date: Mar 23, 2017	Drawn by: MP	Reviewed: AM/MS

GOLDCORP

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5.4 POTENTIAL CUMULATIVE EFFECTS

The projects and activities listed in **Table 5.3-1** were assessed based on location and type of activity. Those projects and activities that have resulted in or may result in a residual adverse effect to Wildlife and Wildlife Habitat that could interact with the residual effects of the Project are summarized in **Table 5.4-1**. The potential for interactions was determined by considering the spatial and temporal overlap of the existing or future foreseeable project/activity with the RAA of each subcomponent. Projects and activities deemed to have potential for cumulative interactions with the Project were those that:

- Could be reasonably characterized in terms of their spatial and temporal boundaries
- Have resulted in or could result in residual adverse effects to Wildlife and Wildlife Habitat that overlap spatially and temporally with the residual effects of the Project.

Potential projects and activities were considered not to have potential for cumulative interactions if:

- The available spatial and temporal information indicated there was overlap with another project or activity that had a larger footprint; or,
- The spatial or temporal extent of a potential project or activity was deemed too small to have a significant interaction with the Project.

For existing projects, the data inputs to the effects assessment were considered, because in some cases the existing disturbance was already incorporated into habitat modeling for species effects assessments.

Table 5.4-1 Potential Cumulative Effects on Wildlife and Wildlife Habitat from Interactions between the Project and Other Projects and Activities

Other Project / Activity	Potential Residual Adverse Effect	Potential for Interaction Resulting in Cumulative Effect (see Note) and Rationale
Quartz exploration (Past, Present, Future)	Habitat loss Reduced habitat effectiveness	Yes — There are multiple quartz exploration projects that could interact cumulatively with wildlife VCs. Exploration activities create localized habitat loss and reduced habitat effectiveness due to sensory disturbance in the ZOI.
Quartz mining (Past, Present, Future)	Habitat loss Reduced habitat effectiveness Alteration to movement Mortality risk	Yes — There are existing and reasonably foreseeable future quartz mines within the wildlife RAAs that may interact cumulatively with the Coffee Creek Project. Other quartz mines activities are likely to have similar residual effects on wildlife and wildlife habitat, including, habitat loss within portions of the permitted areas; reduced habitat effectiveness due to sensory disturbance in the ZOI; creation of barriers to animal movement; and, increase in risk of mortality due to vehicle collisions, hunting, or predation.
Placer mining (Past, Present, Future)	Habitat loss Reduced habitat effectiveness	Yes — There are numerous past, present, and future placer claims within the wildlife RAAs that may interact cumulatively with the Coffee Gold Mine project. Placer mining can remove wildlife habitat within portions of the permitted area and create indirect habitat loss via sensory disturbance.

Other Project / Activity	Potential Residual Adverse Effect	Potential for Interaction Resulting in Cumulative Effect (see Note) and Rationale
Industrial (Present and Future)	Reduced habitat effectiveness	No — Potential interactions from present and future industrial projects are located within established communities or along road ROWs. An effect from these projects will not be distinguishable from effects of settlements and roads.
Utilities (Present and Future)	Reduced habitat effectiveness	No — Potential interactions from present and future utilities projects are located within established communities or along road ROWs. An effect from these projects will not be distinguishable from effects of settlements and roads.
Energy (Present)	Reduced habitat effectiveness	No – Potential interactions from present and future energy projects are located within established communities, along road ROWs, or part of quartz mining footprints. An effect from these projects will not be distinguishable from effects of settlements, roads, and quartz mining.
Transportation (Present)	Habitat loss Alteration to movement Mortality risk	No — Potential interactions from present and future transportation projects are located within established communities or along road ROWs. An effect from these projects will not be distinguishable from effects of settlements and roads.
Forestry (Past)	Habitat loss Alteration to movement Mortality risk	No — Forestry projects identified in the wildlife RAAs are all past activities that should be returning to a naturally vegetated state. Any effects these projects will be assessed as part of existing ground disturbance and roads.
Agriculture (Present)	Habitat loss	No — Agricultural activities do not overlap with residual effects from the Coffee Gold Mine Project. An interaction with wildlife or wildlife habitat could occur, but would not be expected to result in a cumulative effect.
Settlements (Present)	Habitat loss Alteration to movement Mortality risk	Yes — Existing communities have the potential to have residual effects on wildlife that interact with the Project. Other present settlement projects are located within these established communities or along road ROWs. An effect from these projects will not be distinguishable from effects of existing communities and roads.
Existing road network	Habitat loss Alteration to movement Mortality risk	Yes — Roads result in direct habitat loss and creates potential barriers to movement. Vehicle traffic also creates sensory disturbance to wildlife and has the potential to increase collision-related wildlife mortalities.
Trapping and hunting	Mortality Risk	No — Any disturbance from hunting and trapping would be short-term and localized and is not likely to interact cumulatively, assuming harvesting activities are well managed and do not exceed sustainable harvest thresholds.

Note: No: no interaction or not likely to interact cumulatively; Yes: potential for cumulative effect.

The projects or activities that are expected to have an interaction with the Project were included in the CEA for Wildlife and Wildlife Habitat. The CEA for all Wildlife and Wildlife Habitat subcomponents used the following assumptions regarding spatial and temporal boundaries of other projects and activities:

- **Placer mining**: All past, present, and reasonably foreseeable future placer projects were assumed to be active throughout the life of this Project. Spatial data available comprises placer land use permit areas for each project (GeomaticsYukon 2016a). Timing of placer mining is seasonal in the summer.
- **Quartz Exploration**: All past, present, and reasonably foreseeable future quartz exploration projects were assumed to be active throughout the life of this Project. Each project was assumed to have a 10 ha footprint around the project center, based on the project coordinates from the YESAB On-line Registry. Quartz exploration is seasonal in the summer.
- **Quartz mining (past and present)**: Footprints for present (Brewery Creek, Minto) and past mines (Mt Nansen, Clinton Creek) were digitized by hand based on the existing disturbance footprints visible in satellite imagery.
- **Quartz mining (future)**: Reasonably foreseeable future mines considered in this assessment were Casino, Revenue, Hoochekoo, Carmacks, and Lonestar. Where available (Casino, Carmacks), proposed mine footprints from YESAB submissions were used to defined expected disturbance areas. Where proposed footprints were not available (Revenue, Hoochekoo, and Lonestar), a probable disturbance area was inferred by digitizing areas of concentrated exploration activity within each claim from satellite imagery[4].
- **Roads**: The spatial extent of disturbance due to roads was based on roads data from YG (GeomaticsYukon 2016b; GeomaticsYukon 2016c). All features classified as roads or limited-use-roads were included. Roads were categorized as paved all-season, unpaved all-season, or unpaved seasonal according to shapefile attributes. Each road category was assigned a width following EDI 2013 (paved roads: 20 m and unpaved: 8 m), lines were converted to polygons using these widths.
- **General disturbance:** Data from YG that maps existing surface disturbances based on high resolution satellite imagery was included capture spatial footprints of settlements and forestry (Unpublished data, YG 2016). Including this spatial layer also ensures that estimates in the CEA incorporates any present and past habitat effects associated with other projects and activities that were not captured in the Project and Activity Inclusion List in the Project Proposal (**Section 5.0 Assessment Methodology, Appendix 5-B**).

These average footprint sizes are conservative to capture the worst-case scenario for potential cumulative effects; it is unlikely that all quartz and placer projects would operate to these extents during the life of the Project. Furthermore, the likelihood of these projects occurring consecutively and year-round with the Project is unknown; however, based on mining history in Yukon, consecutive operation is unlikely.

4 There were no identifiable areas of concentrated exploration within the Hoochekoo quartz mining claim; a similar area to Carmacks Cooper was placed in the middle of the Hoochekoo quartz license area.

5.5 MITIGATION MEASURES FOR CUMULATIVE EFFECTS

There are no additional Project-specific mitigation measures proposed beyond what the Proponent has already committed to at the Project-specific level, and those mitigation measures are described in detail in **Section 4.3** of this effects assessment and in the WPP (**Appendix 31-F**).

Other land users have the potential to cause significant adverse effects to wildlife within the Project area. The Proponent does not have the ability to manage the public's ability to hunt or the actions of other businesses (e.g., outfitting, trapping, mining) operating within the RAAs. Furthermore, proponents of other projects in the area may have conditions in their operating permits that are inconsistent with the Project's mitigation measures.

5.5.1 PARTICIPATION IN REGIONAL MANAGEMENT/PLANNING GROUPS

To mitigate potential adverse effects that are outside of the Proponent's control and ensure the long-term health of regional wildlife populations, a landscape level planning process that includes an updated Wildlife Management Plan could be developed by management authorities. This management plan could be developed through a multi-stakeholder working group that includes those parties that have the responsibility for wildlife and land management. Working group members could include YG, First Nations, and the Proponent. While the Proponent cannot develop or implement the plan independently, it can participate as a stakeholder member of the working group.

5.6 RESIDUAL CUMULATIVE EFFECTS AND SIGNIFICANCE OF RESIDUAL CUMULATIVE EFFECTS

This section describes the nature of the residual cumulative effects identified for each Wildlife and Wildlife Habitat subcomponent, including an assessment of significance, at the regional level (i.e., RAA) arising from potential interactions identified in **Table 5.3-1.**

5.6.1 KLAZA CARIBOU SUBCOMPONENT

This section describes residual cumulative effects for Klaza Caribou based on interactions identified in **Table 5.4-1**. Following the successful implementation of the mitigation measures descried in **Section 5.5**, two residual cumulative effects are expected to remain: habitat loss due to project/activity footprints and reduced habitat effectiveness due to sensory disturbance.

5.6.1.1 Habitat Loss and Reduced Habitat Effectiveness

Direct habitat loss for Klaza Caribou was estimated based on the information available for other projects and activities within the KC-RAA. A master list of other past, present, and reasonably foreseeable future projects and activities with potential residual adverse effects on Klaza Caribou that could interact with the Project is provided in **Table 5.3-1**. Cumulative habitat loss and reduced habitat effectiveness were assessed following the same methods used for the cumulative effects assessment for Fortymile Caribou

(**Section 5.6.1**). The combined disturbance footprint of all past, present, and reasonably foreseeable future projects and activities that could interact with the Project was used to measure direct habitat loss. Calculation of direct habitat loss for each project/activity category was completed based on the assumptions identified in **Section 5.3**.

The ZOI approach described for Fortymile Caribou (**Section 5.6.1**) was used for the Klaza Caribou CEA Quartz exploration and placer mining occur during the summer and may interact with Klaza Caribou. The magnitude of habitat effects for Klaza Caribou was assessed using the same habitat disturbance thresholds described in the CEA for Fortymile Caribou.

Fire was considered a habitat disturbance as it was for the FMCH in **Section 5.6.1.1**. Within the KCH-RAA, 19.60% of habitat has been burned within the last 50 years (**Table 5.6-8**). Based on the Wildfire Burn Probability Analysis completed for the Project (**Appendix 16-E**), there is no area in the KC-RAA with a greater than 50% probability of burning over the next 25 years. Habitat loss and reduced habitat effectiveness associated with anthropogenic disturbances currently on the landscape and in the future will affect 5.84% of habitat within the KC-RAA. Therefore, the cumulative effect on habitat within the KC-RAA due to both natural (i.e., fire) and anthropogenic disturbances is 25.44% (**Table 5.6-8**), which is below the 35% habitat disturbance threshold identified by Environment Canada (2011) to allow for a self-sustaining population of caribou at the range level. Of that 25.44%, the habitat loss and reduced habitat effectiveness anticipated from the Project is only 0.35% of the KC-RAA, which is a negligible contribution, especially considering the amount of habitat disturbed from fire alone.

Table 5.6-1 Cumulative Habitat Loss and Reduced Habitat Effectiveness for Klaza Caribou

Habitat Effect	Habitat Effect Multiplier[1]	Habitat Loss or Reduced Habitat Effectiveness (excluding late winter range) (km²)	Habitat Loss or Reduced Habitat Effectiveness (including late winter range) (km²)	Cumulative Percent of KC-RAA
Coffee Gold Mine Project				
Habitat loss	-	6.6	0	0.06%
Reduced habitat effectiveness	See **Section 4.4.4**	30.9	0	0.29%
Other Projects and Activities				
Habitat loss	-	96.3	3.1	0.92%
Reduced habitat effectiveness	0.5	713*0.5 = 356.5	277*0.5=138.5	4.58%
Natural Disturbance (i.e., fires)				
Habitat loss from fire (burns 50 years old and younger)	-	1132	988	19.60%
Habitat with ≧50% cumulative probability of burning in next 25 years	-	0	0	0

Habitat Effect	Habitat Effect Multiplier[1]	Habitat Loss or Reduced Habitat Effectiveness (excluding late winter range) (km^2)	Habitat Loss or Reduced Habitat Effectiveness (including late winter range) (km^2)	Cumulative Percent of KC-RAA
Total Cumulative Habitat Disturbance within KC-RAA		**1622.3**	**1129.6**	**25.44%**

1 The habitat effect multiplier is based on the level of reduced habitat effectiveness. A habitat effect multiplier of 0.5 equates to 50% reduced habitat effectiveness.

Note: The KC-RAA is 10,819 km^2.

The residual cumulative effects of the Project and other projects and activities on Klaza Caribou habitat will likely be adverse in direction, moderate in magnitude, regional in geographic extent, year-round in timing, continuous in frequency, and long-term in duration (**Table 5.6-9**). The effect of fire on Klaza Caribou habitat should be considered mainly for the Klaza Caribou winter range as caribou use lichens as primary forage during the winter when other forage options are limited (Johnson et al. 2004). Therefore, the 19.60% of habitat loss attributed to fire within the KC-RAA is an overestimate of habitat loss considering burned areas still provide adequate forage for caribou in non-winter months (reviewed in Anderson and Johnson 2014). The residual cumulative effects are considered partially reversible as some of the disturbed habitats could be reclaimed when projects or activities are completed, while other disturbed habitats (e.g., primary roads and highways) are expected to persist indefinitely. The likelihood of the residual cumulative effects occurring is considered likely because Klaza Caribou and their habitat are known to occur within the KC-RAA. The context for Klaza Caribou is considered high because the herd is well monitored and has most likely increased in size since its last assessment.

Given that the residual cumulative habitat effects do not exceed the 35% habitat disturbance threshold identified by Environment Canada (2011), and that the majority of this habitat loss is due to fire alone (19.60%), much of which affects non-winter habitat for the KCH and is most likely still used by Klaza Caribou, the residual cumulative effects on habitat are considered not significant. As such, the residual cumulative effects should not pose a risk to the long-term persistence and viability of the KCH at the regional level (i.e., KC-RAA). The level of confidence in this significance determination is moderate. Although the confidence rating was based on the known occurrence of Klaza Caribou and caribou habitat within the KC-RAA, and the expected interaction with anthropogenic and fire disturbance, there is uncertainty regarding the spatial and temporal extents of other projects and activities within the KC-RAA.

Table 5.6-2 Cumulative Effect Characteristics Ratings for Klaza Caribou Habitat

Cumulative Effects Characteristic	Rating	Rationale for Rating
Direction	Adverse	The loss of potential caribou habitat would be adverse.
Magnitude	Moderate	Habitat loss and reduced habitat effectiveness from anthropogenic disturbance in the KC-RAA would be low (5.84%); however, this is offset by the incorporation of fire disturbance, which has a greater influence on the amount of potential caribou habitat (19.60%).
Geographic Extent	Regional	Cumulative effects will occur across the KC-RAA.
Timing	Year-round	Habitat effects will occur within the annual range for the KCH.
Frequency	Continuous	Potential caribou habitat would be affected over the life of the Project (i.e., 20 years).
Duration	Long-term	Potential caribou habitat would be affected over the life of the Project (i.e., 20 years).
Reversibility	Partially reversible	Some of the disturbed habitats could be reclaimed when projects or activities are completed, while other disturbed habitats (e.g., primary roads and highways) are expected to persist indefinitely.
Likelihood	Likely	Klaza Caribou and their habitat are known to occur within the KC-RAA.

5.6.1.2 Summary of Residual Cumulative Effects and Significance for Klaza Caribou

Residual cumulative effects, contributing projects and activities, and proposed mitigation measures for Klaza Caribou are summarized in **Table 5.6-10**. Residual cumulative effects for Klaza Caribou include habitat loss due to project/activity footprints and reduced habitat effectiveness due to sensory disturbance. The residual cumulative effects of habitat loss and reduced habitat effectiveness were assessed as low in magnitude as the total habitat altered was less than the identified threshold of 35%. The context for Klaza Caribou was considered high because the herd is well monitored and has most likely increased in size since its last assessment. Based on these considerations, the residual cumulative effects on habitat were considered not significant and should not pose a risk to the long-term persistence and viability of the KCH at the regional level (i.e., KC-RAA). The level of confidence in the significance determinations is moderate. Although the confidence rating was based on the known occurrence of Klaza Caribou and caribou habitat within the KC-RAA, there is uncertainty regarding the spatial and temporal extents of other projects and activities within the KC-RAA.

Table 5.6-3 Summary of Residual Cumulative Effects on Klaza Caribou

Residual Cumulative Effects	Contributing Project Activities	Proposed Mitigation Measures	Residual Effects Characterization (see Notes for details)										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat Loss and Reduced Habitat Effectiveness	• Quartz exploration • Quartz mining • Placer mining • Settlements • Existing road network • Other surface disturbances	• Project Design • Project Personnel Wildlife Awareness Orientation • Minimize Habitat Disturbance • Wildlife Protection Protocols • Manage Traffic • Manage Aircraft Operations	A	M	Regional	Y	L	C	P	L	H	NS	M

Residual Effects Characterization:

Direction: P = Positive, A = Adverse
Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent: Local = Project footprint or ZOI, RAA = Regional, T = Territorial
Timing: Seasonal: (W)inter or (S)ummer, Y= Year-round
Duration: S = Short Term, L = Long-term, P = Permanent
Frequency: I = Infrequent, F = Frequent, C = Continuous
Reversibility: F = Fully Reversible, P = Partially Reversible, I = Irreversible
Likelihood: U = Unlikely, L = Likely
Context: High = H, Moderate = M, L = Low
Significance: NS = Not-Significant, S = Significant
Level of Confidence: H = High, M = Moderate, L = Low

5.6.2 Moose Subcomponent

This section describes residual cumulative effects on Moose based on interactions identified in **Table 5.4-1.** Following the successful implementation of the mitigation measures described in **Section 5.5**, three residual cumulative effects are expected to remain: habitat loss due to project/activity footprints, reduced habitat effectiveness due to sensory disturbances, and increased mortality risk due to collisions with vehicles. The late-winter habitat suitability index produced for the Wildlife RSA during baseline field studies was used for the CEA (refer to **Section 4.4.5** and the Moose Late Winter Habitat Suitability Report, **Appendix 16-C2**).

5.6.2.1 Habitat Loss and Reduced Habitat Effectiveness

Direct habitat loss for Moose was estimated based on the information available for other projects and activities within the W-RAA. A master list of other past, present, and reasonably foreseeable future projects and activities with potential residual adverse effects on Moose that could interact with the Project is provided in **Table 5.3-1**. Cumulative habitat loss and reduced habitat effectiveness were assessed following the same methods used for the Project-related effects assessment for Moose described in **Section 4.4.5**. The combined disturbance footprints of all past, present, and reasonably foreseeable future projects and activities that could interact with the Project was used to measure direct habitat loss. Calculation of direct habitat loss for each project/activity category was completed based on the assumptions identified in **Section 5.3**.

A ZOI approach was used to determine reduced habitat effectiveness due to sensory disturbance and included a 300 m ZOI around the Project footprint, quartz mines, and other surface disturbances. A ZOI was not included around quartz exploration sites or placer projects because those activities occur during summer; therefore, sensory disturbance will not be an issue during late winter.

The residual cumulative effects of habitat loss and reduced habitat effectiveness on late winter habitat for Moose were assessed based on the amount of effective late winter habitat (i.e., high and moderate-rated) within the W-RAA. Given the assumptions identified above, past, present, and reasonably foreseeable future projects and activities (excluding the Project) could directly affect 3.41% of suitable late winter habitat within the W-RAA. The Project will contribute an additional 0.14% to direct habitat loss within the W-RAA). An additional 1.86% of suitable late-winter habitat within the W-RAA could experience reduced habitat effectiveness from other projects and activities. The Project will contribute an additional 0.74% to reduced habitat effectiveness within the W-RAA. The combined cumulative effects of habitat loss and reduced habitat effectiveness could alter up to 6.14% of effective late-winter habitat within the W-RAA (**Table 5.6-11**).

Table 5.6-4 Cumulative Habitat Loss and Reduced Habitat Effectiveness for Moose

Habitat Suitability Class	Total Area in W-RAA	Existing / Future Projects and Activities		Coffee Gold Mine Project		Total Habitat Altered
		Habitat Loss	Reduced Habitat Effectiveness	Habitat Loss	Reduced Habitat Effectiveness	
	km²	km² (%)	km² (%)	km² (%)	km² (%)	km² (%)
High	3584.45	101.74 (2.84)	46.56 (1.30)	4.15 (0.12)	23.99 (0.67)	176.44 (4.92)
Moderate	2245.35	96.92 (4.32)	61.80 (2.75)	3.99 (0.18)	18.90 (0.84)	181.61 (8.09)
Total Suitable Habitat	**5829.80**	**198.66 (3.41)**	**108.36 (1.86)**	**8.14 (0.14)**	**42.89 (0.74)**	**358.05 (6.14)**

Note: To avoid double-counting, areas of the Coffee Gold Mine Project that overlap existing and future disturbances are included under the habitat loss and reduced habitat effectiveness for the Coffee Gold Mine Project.

The residual cumulative effects of the Project and other projects and activities on Moose habitat will likely be adverse in direction, low in magnitude, regional in geographic extent, seasonal in timing (i.e., winter), continuous in frequency, and long-term in duration (**Table 5.6-12**). The residual cumulative effects are considered partially reversible because the risk in some areas may decrease when projects/activities are completed and human presence and vehicle traffic are reduced, while other features (e.g., primary roads and highways) are expected to persist indefinitely. The likelihood of the residual cumulative effects occurring is considered likely because effective Moose habitat occurs within the W-RAA. The context for Moose is considered high because Moose are likely resilient to habitat disturbance, preferring younger habitats for foraging and known occurrences near disturbed habitat. Based on these considerations, the residual cumulative effects on habitat were considered not significant and should not pose a risk to the long-term persistence and viability of the Moose population at the regional level (i.e., W-RAA). The level of confidence in the significance determination is moderate. Although the confidence rating was based on the known occurrence of Moose within the W-RAA, there is uncertainty regarding the spatial and temporal extents of other projects and activities within the W-RAA.

Table 5.6-5 Cumulative Effect Characteristics Ratings for Moose Habitat

Residual Cumulative Effects Characteristic	Rating	Rationale for Rating
Direction	Adverse	The direct or indirect loss of effective late winter habitat would be adverse.
Magnitude	Low	The estimated loss of late winter habitat within the W-RAA due to the Coffee Mine Project and other project/activity footprints and sensory disturbances would be 6.14%.
Geographic Extent	Regional	The effect would occur at the regional level.
Timing	Seasonal (winter)	Late winter habitat is identified as a limiting factor for Moose.
Frequency	Continuous	Effective late winter habitat would be affected over the life of the Project (i.e., 20 years).
Duration	Long-term	Effective late winter habitat would be affected over the life of the Project (i.e., 20 years).
Reversibility	Partially reversible	Some of the disturbed habitat could be reclaimed when projects or activities are completed, while other projects and activities (e.g., primary roads and highways) are expected to persist indefinitely.
Likelihood	Likely	Direct habitat loss has already occurred or is currently occurring due to a number of other projects and activities operating within the W-RAA. Future projects are currently planned and will likely result in direct loss of habitat.

5.6.2.2 Mortality Risk

The addition of other projects and activities within the W-RAA could increase mortality risk for Moose. Potential pathways increasing mortality risk for Moose include increased vehicle traffic resulting in increased collisions with wildlife, improved access for hunters into previously inaccessible areas, increased human-wildlife interactions, and facilitated predation. Existing quotas and harvest management by YG will reduce the risk of increased mortality for all game species, including Moose. Increased hunter access throughout the W-RAA as a result of road construction and upgrades associated with other projects and activities is estimated to have a minimal effect on wildlife harvest rates and is not considered further in the CEA. As described in **Section 4.4.5**, human-wildlife interactions and facilitated predation by wolves are expected to be negligible and are not considered further in the CEA.

Collisions between Moose and other project and activity vehicle traffic are anticipated to present the highest risk to Moose mortality, as described in **Section 4.4.5**. Although mitigation measures for other projects and activities within the RAA are not known, it can be assumed that they are similar in scope and magnitude to the Project. Most existing and proposed projects and activities involve quartz or placer mining and are anticipated to be smaller in scope than the Project. In the worst case scenario, it can be assumed that all proposed projects and activities will be constructed and will have an identical mortality risk for Moose as a result of increased vehicular traffic. According to calculations presented in **Section 4.4.5.3**, this would result in an additional 0.24 collisions with Moose per year ([23 proposed future projects + the Project] * 0.01 Moose collisions per year) across the W-RAA. Seen in the context of annual average kill rates (48 Moose per year including all GMSs within the W-RAA), this would represent a 0.5% increase in the annual kill rate, which would represent a 0.01% increase in the average harvest rate over the 2006–2015 rate ([48 Moose killed/3,032 total Moose] compared to [48.24 Moose killed/3,032 total Moose]) from 1.58% to 1.59%. Even accommodating for the worst case scenario, this rate is still below the threshold of 2%.

The residual cumulative effect of other projects and activities on increased mortality risk for Moose will likely be adverse in direction, low in magnitude, regional in geographic extent, year-round in timing, infrequent in frequency, and long-term in duration (**Table 5.6-13**). The residual cumulative effect is considered partially reversible because mortality risk in some areas may decrease when projects/activities are completed and human presence and vehicle traffic are reduced, while other features (e.g., primary roads and highways) are expected to persist indefinitely. The likelihood of the residual cumulative effects occurring is considered is likely because Moose are known to occur in the W-RAA. The context for Moose is considered high because Moose are expected to be resilient to minimal increases in annual mortality.

No quantitative thresholds exist to assess the change in mortality risk for Moose; therefore, cumulative effects that will be considered significant are those that are adverse in direction, high in magnitude, and long-term in duration. The same threshold for significance determination was applied for potential Project-related effects on Moose (**Section 4.4.5**). As the cumulative effect of increased mortality risk on Moose is not high in magnitude, the cumulative effect is not significant. The level of confidence in the significance determination is moderate. Although the confidence rating was based on the known occurrence of Moose within the W-RAA, there is uncertainty regarding Project-related mortality and mortality risk related to other projects and activities within the W-RAA.

Table 5.6-6 Cumulative Effect Characteristics Ratings for Moose – Mortality Risk

Residual Cumulative Effects Characteristic	Rating	Rationale for Rating
Direction	Adverse	The effect would result in an increase to mortality risk.
Magnitude	Low	The magnitude of the effect was assessed as low. If Project-related mortality occurs, it will be of individual animals.
Geographic Extent	Regional	The effect would occur at the regional level.
Timing	Year-round	Moose are present year-round.
Frequency	Infrequent	Mortality events should be infrequent.
Duration	Long-term	The potential for increased mortality risk would be a long-term.
Reversibility	Partially reversible	Risk in some areas may decrease when projects or activities are completed as human presence and vehicle traffic are reduced while other projects and activities (e.g. primary roads and highways) are expected to persist indefinitely.
Likelihood	Likely	Potential for increased mortality risk is likely due to increased human activity, traffic, and access for hunters.

5.6.2.3 Summary of Residual Cumulative Effects and Significance for Moose

Residual cumulative effects, contributing projects and activities, and proposed mitigation measures for Moose are summarized in **Table 5.6-14**. Residual cumulative effects for Moose include habitat loss due to project/activity footprints, reduced habitat effectiveness due to sensory disturbance, and mortality risk due to collisions with vehicles. The residual cumulative effects of habitat loss and reduced habitat effectiveness were assessed as low in magnitude as the total habitat altered was <10% of the W-RAA. The residual cumulative effect of mortality risk due to collisions with vehicles was also assessed as low in magnitude. The context for Moose was considered high because Moose are likely resilient to habitat disturbance, preferring younger habitats for foraging, and Moose are expected to be resilient to minimal increases in annual mortality. Based on these considerations, the residual cumulative effects on habitat and mortality risk were considered not significant and should not pose a risk to the long-term persistence and viability of the Moose population at the regional level (i.e., W-RAA). The level of confidence in the significance determinations is moderate due to uncertainty regarding mortality risk related to other projects and activities within the W-RAA, and uncertainty regarding the spatial and temporal extents of other projects and activities within the W-RAA.

Table 5.6-7 Summary of Residual Cumulative Effects on Moose

Residual Cumulative Effects	Contributing Project and Activities	Proposed Mitigation Measures	Residual Effects Characterization (see Notes for details)										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat Loss and Reduced Habitat Effectiveness	• Quartz exploration • Quartz mining • Placer mining • Settlements • Existing road network • Other surface disturbances	• Project Design • Minimize Habitat Disturbance	A	L	Regional	W	L	C	P	L	H	NS	M
Mortality Risk	• Quartz exploration • Quartz mining • Placer mining • Settlements • Existing road network • Other surface disturbances	• Project Design • Project Personnel Wildlife Awareness Orientation • Wildlife Protection Protocols • Manage Traffic • Reduce Barriers to Movement • Prevent Wildlife Entrapment	A	L	Regional	Y	L	I	P	L	H	NS	M

Residual Effects Characterization:

Direction: P = Positive, A = Adverse
Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent: Local = Project footprint or ZOI, RAA = Regional, T = Territorial
Timing: Seasonal: (W)inter or (S)ummer, Y= Year-round
Duration: S = Short Term, L = Long-term, P = Permanent
Frequency: I = Infrequent, F = Frequent, C = Continuous
Reversibility: F = Fully Reversible, P = Partially Reversible, I = Irreversible
Likelihood: U = Unlikely, L = Likely
Context: High = H, Moderate = M, L = Low
Significance: NS = Not-Significant, S = Significant
Level of Confidence: H = High, M = Moderate, L = Low

5.6.3 THINHORN SHEEP SUBCOMPONENT

This section describes residual cumulative effects for Thinhorn Sheep based on interactions identified in **Table 5.4-1**. Following the successful implementation of the mitigation measures described in **Section 5.5**, three residual cumulative effects are expected to remain: habitat loss due to project/activity footprints, reduced habitat effectiveness due to sensory disturbance, and alteration to movement. The Thinhorn Sheep HSI produced for the Wildlife RSA during baseline field studies was used for the CEA (refer to **Section 4.4.6** and the Thinhorn Sheep Habitat Suitability Report, **Appendix 16-C3**).

5.6.3.1 Habitat Loss and Reduced Habitat Effectiveness

Direct habitat loss for Thinhorn Sheep was estimated based on the information available for other projects and activities within the TS-RAA. A master list of other past, present, and reasonably foreseeable future projects and activities with potential residual adverse effects on Thinhorn Sheep that could interact with the Project is provided in **Table 5.3-1**. Cumulative habitat loss and reduced habitat effectiveness were assessed following the same methods used for the Project-related effects assessment for Thinhorn Sheep (**Section 4.4.6**). The combined disturbance footprint of all past, present, and reasonably foreseeable future projects and activities that could interact with the Project was used to measure direct habitat loss. Calculation of direct habitat loss for each project/activity category was completed based on the assumptions identified in **Section 5.3**. A 500 m ZOI around all disturbed areas was used to quantify reduced habitat effectiveness due to sensory disturbance.

The residual cumulative effects of habitat loss and reduced habitat effectiveness on Thinhorn Sheep habitat were assessed based on the amount of suitable habitat (i.e., high and moderate-rated) within the TS-RAA. Given the assumptions identified above, past, present, and reasonably foreseeable future projects and activities (excluding the Project) could directly affect 0.36% of suitable habitat within the TS-RAA (**Table 5.6-15**). The Project will contribute an additional loss of 0.17% of suitable habitat within the TS-RAA. An additional 3.58% of suitable Thinhorn Sheep habitat within the TS-RAA could experience reduced habitat effectiveness within a ZOI. The Project's ZOI will reduce effectiveness in an additional 4.87% of suitable habitat within the TS-RAA. The combined cumulative effect of habitat loss and reduced habitat effectiveness could alter up to 8.98% of suitable Thinhorn Sheep habitat within the TS-RAA, which is within the low habitat disturbance threshold described in **Section 4.4.1**.

Table 5.6-8 Cumulative Habitat Loss and Reduced Habitat Effectiveness for Thinhorn Sheep

Habitat Ratings	Total Area in TS-RAA	Existing / Future Projects and Activities		Coffee Gold Mine Project		Total Habitat Altered
		Habitat Loss	Reduced Habitat Effectiveness	Habitat Loss	Reduced Habitat Effectiveness	
	km²	km² (%)	km² (%)	km² (%)	km² (%)	km² (%)
High	14.50	0.005 (0.03)	0.18 (1.27)	0.00 (0.00)	1.07 (7.39)	1.26 (8.69)
Moderate	36.39	0.18 (0.50)	1.64 (4.51)	0.09 (0.23)	1.40 (3.86)	3.31 (9.10)
Total Suitable Habitat	**50.89**	**0.19 (0.36)**	**1.82 (3.58)**	**0.09 (0.17)**	**2.48 (4.87)**	**4.57 (8.98)**

*Percentages are based on the proportion of each habitat type within the entire TS-RAA. Note: To avoid double-counting, areas of the Coffee Gold Mine Project that overlap existing and future disturbances are included under the habitat loss and reduced habitat effectiveness for the Coffee Gold Mine Project.

The residual cumulative effects of the Project and other projects and activities on Thinhorn Sheep habitat will likely be adverse in direction, low in magnitude, regional in geographic extent, year-round in timing, continuous in frequency, and long-term in duration (**Table 5.6-16**). The residual cumulative effects are considered partially reversible because some areas will be reclaimed after projects and activities are completed, while other projects and activities (e.g., primary roads and highways) are expected to persist indefinitely. The likelihood of the residual cumulative effects occurring is considered likely because there are existing and future projects/activities that overlap effective Thinhorn Sheep habitat. The context for Thinhorn Sheep is considered high because (1) a very small proportion of the total effective habitat is subject to direct habitat loss; (2) there is a relatively large amount of unoccupied Thinhorn Sheep habitat within the TS-RAA; and (3) wild Thinhorn Sheep are known to use areas in proximity to resource developments and roads, and can habituate to anthropogenic activities at those areas. Based on these considerations, the residual cumulative effects on habitat were considered not significant and should not pose a risk to the long-term persistence and viability of the Thinhorn Sheep population at the regional level (i.e., TS-RAA). The level of confidence in the significance determination is moderate due to limited information on how Thinhorn Sheep respond to sensory disturbance and uncertainty regarding the spatial and temporal extents of other projects and activities within the TS-RAA.

Table 5.6-9 Cumulative Effect Characteristics Ratings for Thinhorn Sheep Habitat

Residual Cumulative Effects Characteristic	Rating	Rationale for Rating
Direction	Adverse	The direct or indirect loss of suitable Thinhorn Sheep habitat would be adverse.
Magnitude	Low	The estimated loss of effective Thinhorn Sheep habitat within the TS-RAA due to the Coffee Mine Project and existing and future project footprints and sensory disturbances would be 8.98% of the suitable habitat within the TS-RAA.
Geographic Extent	Regional	The effect would occur at the regional level.
Timing	Year-round	Thinhorn Sheep reside in the TS-RAA year-round.
Frequency	Continuous	Suitable Thinhorn Sheep habitat would be affected over the life of the Project (i.e., 20 years).
Duration	Long-term	Suitable Thinhorn Sheep habitat would be affected over the life of the Project (i.e., 20 years).
Reversibility	Partially Reversible	Some of the disturbed habitat could be reclaimed when projects or activities are completed, while other projects and activities (e.g., primary roads and highways) are expected to persist indefinitely.
Likelihood	Likely	Suitable habitat for Thinhorn Sheep occurs within the disturbance areas and ZOIs of projects and activities within the TS-RAA.

5.6.3.2 Alteration to Movement

Population dynamics and movement patterns of Thinhorn Sheep within the TS-RAA are not known; however, small populations, like that at the Ballarat occurrence area, would require emigration from other sources to persist over the long-term (see discussion in **Section 4.4.6.3**) The most likely movement corridor for Thinhorn Sheep is along the series of steep hills and ridges on the north side of the Yukon River valley. Actual use of this corridor has not been documented; however, if these migrations are infrequent then they are unlikely to be detected. If movement by Thinhorn Sheep occurs along this potential corridor, then habitat loss and reduced habitat effectiveness associated with current and future projects and activities in this area could affect these movements.

The most likely Thinhorn Sheep movement corridor was identified based on the distribution of sheep habitat from the Thinhorn Sheep habitat model (Thinhorn Sheep Habitat Suitability Report, **Appendix 16-C3**), and the location of the known occurrence areas. This movement corridor was defined as the area within two kilometers of the north shore of the Yukon River, between the Pelly River and Stewart River confluences. This corridor encompasses all large patches of effective Thinhorn Sheep habitat between the three occurrence areas. Residual cumulative effects to Thinhorn Sheep movement were assessed for a larger movement assessment area which included all areas within the TS-RAA on the north side of the Yukon River east of the Stewart River confluence. This larger assessment area was used to account for uncertainty in the route(s) Thinhorn Sheep take to travel between occurrence areas. This was a qualitative assessment, based on the types of barriers presented by each project/activity type and location relative to the Thinhorn Sheep movement corridor and suitable Thinhorn Sheep habitat.

All past, present and reasonably foreseeable future projects and activities within this movement assessment area that could present barriers to Thinhorn Sheep movements were assessed qualitatively. The combined disturbance footprints from placer mining, quartz exploration, quartz mining, existing surface disturbances, and the existing road network were used to assess direct habitat loss and reduced habitat effectiveness due to sensory disturbance. Assumptions about the spatial extents of these projects and activities are described in **Section 5.3**. The magnitude of cumulative effects to Thinhorn Sheep movement was considered moderate if any semi-permeable barriers to movement were identified within the assessment area and high if any impermeable barriers were identified.

Six roads transect the northern shore of the Yukon River, including the NAR for the Project. Four of these roads are unpaved seasonal roads associated with placer claims. Two roads, including the NAR for the Project, are unpaved all-season roads. These are all limited-use roads with low-levels of traffic; therefore, these roads should not prevent movement of Thinhorn Sheep through this corridor. None of the roads transect a patch of effective Thinhorn Sheep habitat within the movement corridor (i.e., 2 km north of the Yukon River). Two of the roads are immediately adjacent to patches of effective (i.e., moderate- or high-rated) Thinhorn Sheep habitat. There are also five quartz exploration projects within the Thinhorn Sheep movement assessment area. Four of these projects are located west of the Ballarat Creek occurrence area and one project is located east of the Ballarat Creek occurrence area. The small footprints associated with quartz exploration are unlikely to present a barrier to Thinhorn Sheep movements.

There are seven placer claims that intersect the Thinhorn Sheep movement corridor; these projects are located on Sparkling Creek, Thistle Creek, Lower Kirkman Creek, Donahue Creek and Frisco Creek. Only the claims on Sparking Creek and Frisco Creek transect the entire Thinhorn Sheep movement corridor and extend to the Yukon River. Two of these seven placer claims (i.e., Kirkman Creek and Donahue Creek) partially overlap patches of effective Thinhorn Sheep habitat within the movement corridor. In the larger movement assessment area, there are an additional six placer claims that are outside of the expected Thinhorn Sheep movement corridor; these projects are located on Kirkman Creek, Ballarat Creek, Lulu Culch, and Frisco Creek. None of these claims overlap areas suitable Thinhorn Sheep habitat. Placer claims likely present a semipermeable barrier to Thinhorn Sheep movement. The noise and human activity could reduce movement through the claim area, potentially causing Thinhorn Sheep to take a longer route through less favorable habitat or to alter the timing and frequency of movements. Placer mining is expected to have the greatest effect on Thinhorn Sheep movements during the summer when mines are seasonally active.

The residual cumulative effects of the Project and other projects and activities on Thinhorn Sheep movement will likely be adverse in direction, moderate in magnitude, regional in geographic extent, year-round in timing, infrequent in frequency, and long-term in duration (**Table 5.6-17**). The residual cumulative effect is considered partially reversible because some of the movement corridors will be reclaimed after projects and activities are completed; however, it is unlikely that all potential barriers within the assessment area will ever be inactive. The likelihood of the residual cumulative effect occurring is considered likely because Thinhorn Sheep probably move between sub-populations within the TS-RAA and there are existing and future projects and activities which could influence those movements. The context for Thinhorn Sheep is considered high because Thinhorn Sheep are likely resilient to semi-permeable barriers presented by roads and placer mines (i.e., wild populations in other parts of western Canada are known to move across these features; see **Section 4.4.6**). Based on these considerations, the residual cumulative effect was considered not significant and should not pose a risk to the long-term persistence and viability of the Thinhorn Sheep population at the regional level (i.e., TS-RAA). The level of confidence in the significance determination is low due to the following:

- Limited information on the timing and location of Thinhorn Sheep movements within the TS-RAA.
- Limited information on how Thinhorn Sheep respond to barriers to movement.
- Limited information on what the individual and population consequences are for alterations to Thinhorn Sheep movements.
- Uncertainty regarding the spatial and temporal extents of other projects and activities within the TS-RAA.

Table 5.6-10 Cumulative Effect Characteristics Ratings for Thinhorn Sheep – Movement

Cumulative Effects Characteristic	Rating	Rationale for Rating
Direction	Adverse	Any reduction in movement between Thinhorn Sheep occurrence areas would have an adverse effect on sub-population viability within the TS-RAA.
Magnitude	Moderate	All potential barriers identified within the predicted corridor are expected to be semi-permeable to Thinhorn Sheep; this may increase costs of movements, but should not prevent movements.
Geographic Extent	Regional	Changes to the movements between sub-populations could affect the Thinhorn Sheep population at a regional level
Timing	Year-round	Thinhorn sheep are present in the TS-RAA year-round and the timing of movements is not known
Frequency	Infrequent	Thinhorn Sheep movements between occurrence areas are only expected to occur a small number of times a year
Duration	Long-term	Some or all of the barriers considered in this assessment are likely to be active beyond the life of the Project (i.e., >20 years)
Reversibility	Partially Reversible	Affects to movement may decrease as projects or activities are completed and human presence and vehicle traffic are reduced; some projects and activities (e.g. roads) could persist indefinitely
Likelihood	Likely	Sub-population dynamics indicate there should be movement between these three occurrence areas and there are existing and future developments that intersect the most likely movement corridor

5.6.3.3 Summary of Residual Cumulative Effects and Significance for Thinhorn Sheep

Residual cumulative effects, contributing projects and activities, and proposed mitigation measures for Thinhorn Sheep are summarized in **Table 5.6-18**. Residual cumulative effects for Thinhorn Sheep include habitat loss due to project/activity footprints, reduced habitat effectiveness due to sensory disturbance, and alteration to movement. The residual cumulative effects of habitat loss and reduced habitat effectiveness were assessed as low in magnitude as the total habitat altered was <10%. The residual cumulative effect of alteration to movement was assessed as moderate in magnitude because there are multiple semi-permeable barriers within the Thinhorn Sheep movement assessment area, but no impermeable barriers associated with projects or activities. The context for Thinhorn Sheep was considered high because Thinhorn Sheep populations are secure in Yukon (Environment Yukon 2016c), wild sheep in other areas have adapted to similar types of sensory disturbance, and Thinhorn Sheep in this region are likely already adapted to the type of disturbance associated with the NAR. Based on these considerations, the residual cumulative effects on habitat and movement were considered not significant and should not pose a risk to the long-term persistence and viability of the Thinhorn Sheep population at the regional level (i.e., TS-RAA). The level of confidence in the significance determinations is moderate due to the following:

- Limited information on the timing and location of Thinhorn Sheep movements within the TS-RAA.
- Limited information on how Thinhorn Sheep respond to barriers to movement.
- Limited information on what the individual and population consequences are for alterations to Thinhorn Sheep movements.
- Uncertainty regarding the spatial and temporal extents of other projects and activities within the TS-RAA.

Table 5.6-11 Summary of Residual Cumulative Effects on Thinhorn Sheep

Residual Cumulative Effects	Contributing Projects and Activities	Proposed Mitigation Measures	Residual Effects Characterization (see Notes for details)										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat Loss and Reduced Habitat Effectiveness	• Quartz exploration • Quartz mining • Placer mining • Settlements • Existing road network • Other surface disturbances	• Project Personnel Wildlife Awareness Orientation • Minimize Habitat Disturbance • Wildlife Protection Protocols • Manage Traffic • Manage Aircraft Operations	A	L	Regional	Y	L	C	P	L	H	NS	M
Alteration to Movement	• Quartz exploration • Quartz mining • Placer mining • Settlements • Existing road network • Other surface disturbances	• Project Design • Project Personnel Wildlife Awareness Orientation • Manage Traffic • Reduce Barriers to Movement	A	M	Regional	Y	L	I	P	L	H	NS	L

Residual Effects Characterization:

Direction: P = Positive, A = Adverse
Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent: Local = Project footprint or ZOI, RAA = Regional, T = Territorial
Timing: Seasonal: (W)inter or (S)ummer, Y= Year-round
Duration: S = Short Term, L = Long-term, P = Permanent
Frequency: I = Infrequent, F = Frequent, C = Continuous
Reversibility: F = Fully Reversible, P = Partially Reversible, I = Irreversible
Likelihood: U = Unlikely, L = Likely
Context: High = H, Moderate = M, L = Low
Significance: NS = Not-Significant, S = Significant
Level of Confidence: H = High, M = Moderate, L = Low

5.6.4 FORTYMILE CARIBOU SUBCOMPONENT

This section describes residual cumulative effects on Fortymile Caribou based on interactions identified in **Table 5.4-1**. Following the successful implementation of the mitigation measures descried in **Section 5.5**, four residual cumulative effects are expected to remain: habitat loss due to project/activity footprints, reduced habitat effectiveness due to sensory disturbance, increased mortality risk due to collisions with vehicles, and alteration to movement. Residual cumulative effects are expected to occur primarily between October and April when Fortymile Caribou may be present within the FC-RAA.

5.6.4.1 Habitat Loss and Reduced Habitat Effectiveness

Direct habitat loss for Fortymile Caribou was estimated based on the information available for other projects and activities within the FC-RAA. A master list of other past, present, and reasonably foreseeable future projects and activities with potential residual adverse effects on Fortymile Caribou that could interact with the Project is summarized in **Table 5.3-1**. Cumulative habitat loss and reduced habitat effectiveness were assessed following similar methods used for the Project-related effects assessment for Fortymile Caribou (**Section 4.4.3**). The combined disturbance footprint of all past, present, and reasonably foreseeable future projects and activities that could interact with the Project was used to measure direct habitat loss. Calculation of direct habitat loss for each project/activity category was completed based on the assumptions of footprint areas identified in **Section 5.3**.

In addition to calculating direct habitat loss from all project and activity footprints, ZOIs were also applied to projects and activity footprints where reduced habitat effectiveness due to sensory disturbance was considered to be an effect that could interact with the Project and result in a cumulative area of reduced habitat effectiveness for Fortymile Caribou.

During late winter, Weir et al. (2007) observed reduced habitat use (i.e., 41% to 51%) by Woodland Caribou within a 4 km ZOI of a mine site during construction and operation. Johnson et al. (2005) hypothesized ZOIs and habitat effects (i.e., 1–5 km and 95–50%, respectively) for major disturbances based on previous approaches for similar species in the Arctic. Furthermore, Johnson et al. (2005) suggested that habitat effectiveness within a 5 km and 15 km ZOI decreases by 50% near mineral exploration sites in the Arctic. Based on these sources, a 50% reduced habitat effect was determined for quartz projects and paved roads, and provides a conservative approach to the assessment. Similar to the assessment of Project-related effects, a 50% reduced habitat effect was also assigned to unpaved all-season roads, such as the NAR as a conservative approach. ZOIs applied to all present and future projects and activities within the FC-RAA, along with anticipated habitat effects and supporting rationale are provided in **Table 5.6-1**.

Table 5.6-12 ZOIs and Anticipated Habitat Effects Applied to Present and Future Projects and Activities within the FC-RAA

Other Project / Activity	ZOI	Habitat Effect[1]	Rationale
Quartz exploration	No ZOI	na	All quartz exploration activities are assumed to occur in the summer, which does not overlap temporally when Fortymile Caribou are present in the FC-RAA; therefore, sensory disturbance associated with this project/activity is not anticipated.
Quartz mining	4 km	50%	4 km ZOI applied to Coffee Creek Project, therefore same ZOI applied to all other mining projects in the FC-RAA, based on anticipated similar sensory disturbances.
Placer mining	No ZOI	na	All placer mining activities are assumed to occur in the summer, which does not overlap temporally with when Fortymile Caribou are present in the FC-RAA, therefore sensory disturbance associated with this project/activity is not anticipated.
Roads	Variable ZOI 1–5 km	50%	ZOIs based on expected size and usage of roads, and knowledge that response to roads is typically hierarchical based on level of activity and size of the road (Wolfe et al. 2000, Dyer et al. 2002, Polfus et al 2011, Leblond et al. 2013). Paved all season road (e.g. Klondike Hwy) — 5 km ZOI Unpaved all season road (e.g. NAR) — 2 km ZOI Seasonal road (e.g. forestry road) — 1 km ZOI
Settlements	9 km	50%	Based on Polfus et al. (2011) caribou avoidance of the town of Atlin, BC in a habitat area similar to the FC-RAA. Includes Dawson City and Pelly Crossing. Although Pelly Crossing is not in the FC-RAA, 2 km of the 9 km ZOI falls within the FC-RAA. A Habitat Effect multiplier was not applied to settlements in this assessment because that effect was strongly correlated with road effects, which were preferentially used in the habitat model (Muhly 2017).
Other surface disturbances	No ZOI	na	Spatial files provided by YG and relate to other surface disturbances that result in habitat loss in the FC-RAA. These other surface disturbances are not well defined from the spatial information available. However, some of these disturbances include forestry, agriculture, and rural disturbances, which are expected to be limited in their extent (spatially and temporally) of sensory disturbance, therefore a ZOI was not applied to these disturbances.

1 The extent to which habitat effectiveness is reduced within a ZOI decreases with distance from a project or activity footprint.

The habitat disturbance threshold for the CEA for Fortymile Caribou is based on the Environment Canada (2011) disturbance threshold of 35% for the boreal population of Woodland Caribou, which, in addition to anthropogenic disturbance, takes into consideration fire history within a herd's range when considering potential effects on Caribou habitat at the range level. While a natural wildfire regime is important for regeneration and productivity of the boreal forest, extensive fires could limit winter habitat availability for Caribou because lichens take many decades to recover (Klein 1982; Thomas and Kiliaan 1998). Overwintering Caribou are known to avoid burned areas for decades while lichen communities regenerate (Joly et al 2007). The number of years required for lichen to regenerate sufficiently for Caribou to start selecting the habitat typically exceeds 50 years after a fire (Anderson and Johnson 2014). When identifying critical habitat for the boreal population of Woodland Caribou in Canada, Environment Canada (2008) selected burned areas 50 years and younger as unsuitable to support a sufficient lichen biomass for winter foraging[5]. During the last 50 years, 19,760 km² (25.49%) of the FC-RAA has burned. The area currently burned is explicitly factored into the Fortymile Caribou habitat model (Muhly 2017; Wildlife Baseline Report, **Appendix 16-A**).

In addition to current burned areas, which are reflected in the habitat model predictions, the probability of burning in the future was also considered. Based on the wildfire burn probability analysis completed for the Project (Fire Risk Modelling Report, **Appendix 15-C**), an additional 753.7 km² (0.97%) of currently undisturbed habitat within the FC-RAA has a greater than 50% probability of burning over the next 25 years. Of the 753.7 km² area, 482.4 km² (1.05%) is potentially suitable caribou habitat, using the RSF-weighted approach described in **Section 4.4.3.3** (**Table 5.6-2**). Although caribou do use burned areas to varying degrees (Joly et al. 2003, Anderson and Johnson 2014, Muhly 2017), as a conservative approach, areas with >50% probability of burning over the next 25 years were considered a cumulative habitat loss for the FMCH within the FC-RAA. Based on proportion of the FC-RAA that is currently burned or has a higher probability of burning over the next 25 years (26.46%), fire is the largest single disturbance in the FC-RAA.

Habitat loss and reduced habitat effectiveness associated with anthropogenic disturbances currently on the landscape and in the future are estimated to have an effect on 1.05% of caribou habitat within the FC-RAA (**Table 5.6-2**). The cumulative effect on habitat within the FC-RAA due to both natural (i.e., fire) and anthropogenic disturbances is 2.55%, which is well below the 35% habitat disturbance threshold identified by Environment Canada (2011) to allow for a self-sustaining population of Caribou at the range level. The habitat disturbance threshold applied to this assessment is intended to be in relation to disturbance within the herd's entire range. The FC-RAA does not cover the full range of the FMCH and only covers the areas in Yukon where Fortymile Caribou occur or can reasonably be expected to use within the coming decade. Satellite collar data indicate that Fortymile Caribou occupy the FC-RAA on average for 76 days (range 1–183 days; **Section 3.3.1**), indicating that they use habitat outside of the FC-RAA during most of the year. Therefore, the cumulative habitat disturbance of 2.55% does not represent the effect on the entire FMCH range, only a portion of the range. Of that 2.55%, the habitat loss and reduced habitat effectiveness anticipated from the Project is only 0.71% of the FC-RAA, which is a very small contribution.

The residual cumulative effects of the Project and other projects and activities on Fortymile Caribou habitat will likely be adverse in direction, moderate in magnitude, regional in geographic extent, seasonal in timing (i.e., winter), continuous in frequency, and long-term in duration (**Table 5.6-3**). The residual cumulative

5 Environment Canada (2011) was an update to Environment Canada (2008) report which selected burned areas 40 years and younger as having unsuitable lichen forage. The selection for younger burns compared to the 2008 report was based on available fire data across jurisdictions, albeit the difference in area was minimal due to the limited number of burns 40–50 years old.

effects are considered partially reversible as some of the disturbed habitats could be reclaimed when projects or activities are completed, while other disturbed habitats (e.g., primary roads and highways) are expected to persist indefinitely. Fires are a natural disturbance and as some forests move through succession to become mature forest, other areas will burn and start the cycle again. It is likely that habitat loss and reduced habitat effectiveness will occur, as Fortymile Caribou are known to occupy the FC-RAA in winter and will interact with some of these disturbances. The likelihood of the residual cumulative effects occurring is considered likely because Fortymile Caribou and their habitat are known to occur within the FC-RAA. The context for Fortymile Caribou is high considering the herd has shown continuous growth since the population low in the 1970s and is not considered listed, and hunting of the herd is currently not permitted, further reducing population stresses for the herd. Based on these considerations, the cumulative effect on Fortymile Caribou habitat is considered not significant and should not pose a risk to the long-term persistence and viability of the FCH at the regional level. The level of confidence in this significance determination is moderate to high. Although detailed information about recent FMCH range movements and habitat use has high confidence, that confidence is somewhat reduced by high variability of the FMCH movements annually. There is also uncertainty regarding spatial and temporal extents and interactions with anthropogenic and fire disturbances within the FC-RAA.

Table 5.6-13 Cumulative Habitat Loss and Reduced Habitat Effectiveness for Fortymile Caribou

Habitat Effect	Habitat Effect Multiplier[1]	Habitat Loss or Reduced Habitat Effectiveness (km^2)	Cumulative Percent of FC-RAA
Coffee Gold Mine Project			
Habitat loss	-	32	0.05%
Reduced habitat effectiveness[2]	See **Section 4.4.3**	302.5	0.66%
Other Projects and Activities			
Habitat loss		24.3	1.37%
Reduced habitat effectiveness[2]	0.5	679.9*0.5 =334.0	3.75%
Natural Disturbance (i.e., fires)			
Habitat with ⩾ 50% cumulative probability of burning in next 25 years	-	482.4	1.05%
Total Cumulative Habitat Disturbance within FC-RAA		**1,172.5**	**2.55%**

1 The habitat effect multiplier is based on the level of reduced habitat effectiveness. A habitat effect multiplier of 0.5 equates to 50% reduced habitat effectiveness.

2 To avoid double-counting, areas that have been affected by fire or have a higher burning probability that overlap with areas of reduced habitat effectiveness from the Project and other present and future projects have not been included in the assessment of reduced habitat effectiveness.

Note: The FC-RAA is 77,532 km^2.

Table 5.6-14 Cumulative Effect Characteristics Ratings for Fortymile Caribou Habitat

Cumulative Effects Characteristic	Rating	Rationale for Rating
Direction	Adverse	The loss of potential caribou habitat would be adverse.
Magnitude	Moderate	Habitat loss and reduced habitat effectiveness from anthropogenic disturbance in the FC-RAA would be low (5.38%); however, this is offset by the incorporation of fire disturbance, which has a greater influence on the amount of potential caribou habitat (26.13%).
Geographic Extent	Regional	Cumulative effects will occur across the FC-RAA.
Timing	Seasonal (winter)	The FC-RAA is used as part of the FMCH winter range, thus habitat effects relate to winter habitat.
Frequency	Continuous	Potential caribou habitat would be affected over the life of the Project (i.e., 20 years).
Duration	Long-term	Potential caribou habitat would be affected over the life of the Project (i.e., 20 years).
Reversibility	Partially reversible	Some of the disturbed habitats could be reclaimed when projects or activities are completed, while other disturbed habitats (e.g., primary roads and highways) are expected to persist indefinitely.
Likelihood	Likely	Fortymile Caribou and their habitat are known to occur within the FC-RAA.

5.6.4.2 Mortality Risk

Mortality risk was assessed qualitatively as the probability of interactions between Fortymile Caribou and vehicle traffic within the FC-RAA resulting in the death of individual caribou. This assessment involved reviewing literature and evaluating the various factors that may influence the risk of caribou-vehicle collisions (e.g., traffic volumes, speed limits, sections of road that might be more frequently crossed by Fortymile Caribou). The magnitude of increased mortality risk was determined relative to the entire FMCH, last estimated at 51,675 Caribou in 2010 (Boertje et al. 2012). It is likely the FMCH is larger today given that the herd has shown continuous growth since the population low in the 1970s (Valkenburg et al. 1994).

Vehicle collisions with Fortymile Caribou on major highways, unpaved all-season roads, and unpaved seasonal roads throughout the FC-RAA are a potential cause of direct mortality. The FC-RAA encompasses a large area in west-central Yukon and includes portions of the Klondike Highway from approximately Carmacks north to Dawson City, approximately 175 km of the Dempster Highway extending north from the junction with the Klondike Highway, and the Top of the World Highway between Dawson City and the Alaska-Yukon border. Large mammal-vehicle collision statistics are available for the major highways within the FC-RAA. A total of 155 large mammal-vehicle collisions were reported along the Klondike Highway between 2003 and 2014 (EDI 2015). Only six of these collisions occurred north of Carmacks; however, none of these collisions involved Caribou (EDI 2015). Only one large mammal-vehicle collision was reported along the Dempster Highway between 2003 to 2014 (i.e., unknown bear species); this collision occurred along the southern section of the highway within approximately 25 km of the junction with the Klondike Highway (EDI 2015). No large mammal-vehicle collisions were reported along the Top of the World Highway between 2003 and 2014 (EDI 2015). It is important to note that these statistics were collected during a time when Fortymile Caribou were largely not in the Yukon part of their range, thus these data limit the ability to confidently characterize wildlife-vehicle collisions in the context of Fortymile Caribou.

Average daily traffic volumes on the Klondike Highway south of Carmacks are considerably higher than average daily traffic volumes on the Klondike Highway north of Carmacks (excluding the Dawson City area), the Dempster Highway, and the Top of the World Highway (**Table 5.6-4**). It is anticipated that average daily traffic volumes on unpaved all-season roads within the FC-RAA would be similar to the Dempster and Top of the World highways (i.e., 50 to 149 vehicles per day on busier unpaved all-season roads; less than 50 vehicles per day on less busy unpaved all-season roads).

Table 5.6-15 Average Daily Traffic Volumes on Major Highways within the FC-RAA

Highway	Section of Highway	Average Daily Traffic Volume
Klondike Highway south of Carmacks	Between Carmacks and Whitehorse	300 to 599
Klondike Highway north of Carmacks	Between Carmacks and Dawson City	150 to 299
	In and around Dawson City	1,200 to 2,399 in Dawson City
		300 to 599 around Dawson City
Dempster Highway	Southern section (approximately 70 km)	50 to 149
	Northern section (approximately 105 km)	<50
Top of the World Highway (closed in winter)	Between Dawson City and the Alaska-Yukon border	50 to 149

Yukon Highways and Public Works (2011)

The probability of vehicle collisions with Fortymile Caribou within the FC-RAA is expected to be low given that (1) no Caribou-vehicle collisions have been reported along major highways within the FC-RAA, particularly the Dempster Highway where the Porcupine Caribou Herd crosses, and (2) average daily traffic volumes on major highways within the FC-RAA are considerably lower than major highways further south. All Caribou-vehicle collisions that were reported in Yukon between 2003 and 2014 occurred along major highways south of Whitehorse (e.g., Klondike Highway, Alaska Highway, Tagish Road) with average daily traffic volumes ranging from 300 to 2,399 vehicles per day (EDI 2015; Yukon Highways and Public Works 2011). In addition, average daily traffic volumes on secondary roads and trails within the FC-RAA are anticipated to be relatively low. Road design features and appropriate mitigation measures (e.g., public awareness campaigns, reduced vehicle speeds, wildlife warning signage, roadside vegetation management, and roadside snow management) will further reduce the risk of Caribou-vehicle collisions on major highways, secondary roads, and trails throughout the FC-RAA.

Based on satellite collar data collected from January 2014 to February 2016 for Fortymile Caribou in Yukon, at present, the majority of Fortymile Caribou stay within the western half of the FC-RAA and interact most frequently with the Top of the World Highway and unpaved all season roads branching off this highway. There is also some interaction with the Dempster Highway and potentially with the Klondike Highway north of Carmacks (i.e., between January 2014 and February 2016, Fortymile Caribou did not cross the Klondike Highway east of Dawson City and only a small proportion of the herd crossed the Dempster Highway into the eastern half of the FC-RAA). Fortymile Caribou are unlikely to interact with the Klondike Highway south of Carmacks until the herd expands their use of range within the eastern half of the FC-RAA. The Top of the World Highway is closed in winter when Fortymile Caribou are most likely to occur within the FC-RAA; therefore, it is unlikely that caribou-vehicle collisions will occur along this highway and secondary roads branching off this highway in winter. The direct mortality risk to Fortymile Caribou migrating across the Dempster Highway and the Klondike Highway north of Carmacks is anticipated to be low given the relatively low average daily traffic volumes along those roads compared to elsewhere in Yukon, particularly when accounting for seasonal variations in traffic volumes (i.e., Fortymile Caribou are most likely to be present during the winter when traffic volumes are likely to be at a low). Additionally, analysis of Fortymile Caribou satellite collar data indicates that migration across these Highways is infrequent (**Figure 2-8**, Wildlife Baseline Report, **Appendix 16-A**).

Between January 2014 to February 2016, a proportion of Fortymile Caribou also migrated across the proposed NAR into the eastern half of the FC-RAA. The direct mortality risk to Fortymile Caribou migrating across the proposed NAR is also anticipated to be low. The Project traffic is planned to be only eight trucks per day and access control at the Yukon and Stewart rivers will limit public access south of the Stewart River. North of the Stewart River, the NAR may experience slightly higher traffic volumes due to non-Project related traffic; however, given that placer mining activities generally do not occur during the winter, traffic volumes are still expected to remain low during the winter months when Fortymile Caribou are most likely to be present. Road design features and appropriate mitigation measures (e.g., public awareness campaigns, reduced vehicle speeds, wildlife warning signage, and roadside snow management) will further reduce the risk of caribou-vehicle collisions on the network of roads throughout the FC-RAA.

No quantitative thresholds exist to assess mortality risk for Fortymile Caribou; therefore, effects that will be considered significant are those that are adverse in direction, high in magnitude, and long-term in duration. The residual cumulative effect of increased mortality risk to Fortymile Caribou is likely to be adverse in direction, low in magnitude, regional in geographic extent, seasonal in timing (i.e., winter), infrequent in frequency, and long-term in duration (**Table 5.6-5**). The residual cumulative effect is considered partially reversible as mortality risk could decrease if traffic levels also decreased; however, major highways and potentially other paved all-season roads will likely persist indefinitely. The likelihood of increased mortality risk to Fortymile Caribou is unlikely given the relatively low daily traffic volumes on these major highways, and lower use of other roads throughout the FC-RAA. The context for the FMCH is high considering the herd has shown continuous growth since the population low in the 1970s, the herd is not a listed species, and there is currently no hunting of the FMCH, reducing population stresses for the herd. Based on these considerations, the residual cumulative effect of mortality risk on Fortymile Caribou is considered to be not significant and should not pose a risk to the long-term persistence and viability of the FMCH at the regional level (i.e., FC-RAA). The level of confidence in this determination of significance is high considering no caribou-vehicle collisions have been reported along major highways within the FC-RAA (e.g. no Caribou-vehicle collisions have been reported along the Dempster Highway where the Porcupine Caribou Herd crosses), and average daily traffic volumes on major highways within the FC-RAA are considerably lower than major highways further south.

Table 5.6-16 Cumulative Effect Characteristics Ratings for Fortymile Caribou – Mortality Risk

Residual Effect Characteristic	Rating	Rationale for Rating
Direction	Adverse	The cumulative effect would result in the direct mortality of one or a small number of caribou in the FMCH.
Magnitude	Low	A measurable cumulative effect would occur at the individual level if one or a small number of caribou were directly killed by caribou-vehicle collisions over multiple years. However, the cumulative effect would be unlikely to pose a risk to the long-term persistence and viability of the entire FMCH at the regional level.
Geographic Extent	Regional	The cumulative effect would occur within the FC-RAA.
Timing	Seasonal (winter)	The cumulative effect would occur in winter between October and April when Fortymile Caribou may be within the FC-RAA.
Frequency	Infrequent	The cumulative effect is expected to occur infrequently. No caribou-vehicle collisions were reported along major highways within the FC-RAA between 2003 and 2014. Average daily traffic volumes on major highways within the FC-RAA are considerably lower than major highways in southern Yukon where large mammal-vehicle collisions are more common. Average daily traffic volumes on other roads within the FC-RAA are also anticipated to be relatively low.
Duration	Long-term	The cumulative effect is expected to persist over the life of the Project (i.e., 20 years).
Reversibility	Partially reversible	The cumulative effect is expected to be partially reversible as mortality risk should decrease following the closure of major projects (e.g., mines) and reduced use of roads associated with these projects. However, major highways and other roads not planned for decommissioning (e.g. NAR) will persist indefinitely and continue to maintain some level of traffic.
Likelihood	Unlikely	The cumulative effect is unlikely to occur given the absence of caribou-vehicle collisions along major highways in the FC-RAA, and relatively low daily traffic volumes on major highways and other roads throughout the FC-RAA.

5.6.4.3 Alteration to Movement

To assess the cumulative effects of the Project and other projects and activities on the movement of the FMCH during winter, late winter ungulate survey data collected in 2014, 2015, and 2016 (EDI 2016) and satellite collar data collected from January 2014 to February 2016 were assessed qualitatively to determine (1) expected occurrence of Fortymile Caribou in the FC-RAA during winter movement periods and (2) potential areas of interaction with movement.

As discussed in **Section 4.4.3**, it appears that the majority of Fortymile Caribou currently stay within the western half of the FC-RAA and interact most frequently with the Top of the World Highway and secondary roads branching off this highway. The Top of the World Highway is closed in winter when Fortymile Caribou are most likely to be present within the FC-RAA; therefore, it is unlikely that this highway and roads branching off this highway in winter will alter caribou movement. This is supported by early winter (October 1 – December 31) and late winter (January 1 – April 30) collar data that suggest that caribou readily cross the Top of the World Highway. A portion of the herd also migrated across the Dempster Highway during the winter of 2013/2014 (**Figure 2-8**, Wildlife Baseline Report, **Appendix 16-A**) with crossings occurring in two general locations (i.e., a southern crossing location approximately 25 km north of the junction with the Klondike Highway; and a northern crossing location approximately 110 km north of the junction with the Klondike Highway). Fortymile Caribou movement across portions of the proposed NAR occurred during the winter of 2015/2016 and likely during the winter of 2013/2014 (although the later was not captured by satellite collar data).

The baseline analysis long-distance movements by satellite collared caribou (Wildlife Baseline Report, **Appendix 16-A**) does not show an effect of roads on the movement of Fortymile Caribou (i.e., the analysis shows that Caribou are crossing roads, including active roads such as the Dempster Highway). Furthermore, the herd regularly crosses highways in Alaska during migration (e.g., the Steese Highway, Taylor Highway, Top of the World Highway). However, it is possible that roads, particularly roads with higher traffic volumes, may have a filter effect on Caribou or may delay Caribou in crossing (refer to discussion in **Section 4.4.3.3**).

It is unlikely that the footprint of active or future mines within the FC-RAA will present a barrier or filter to movement. Mine sites are non-linear, discrete features with visible boundaries that Fortymile Caribou will be able to identify from a distance and easily move around. However, if Caribou decide to migrate through a given mine site, they should be able to do so unimpeded in areas where infrastructure is not present as mine sites are not typically fenced. Placer mines and exploration projects are also discrete features that typically do not operate during winter months and are not expected to alter the movement patterns of Fortymile Caribou.

No quantitative thresholds exist to assess alteration to movement for Fortymile Caribou; therefore, the cumulative effect is considered significant if it is adverse in direction, high in magnitude, and long-term in duration. The residual cumulative effect of alteration to movement for Fortymile Caribou is likely to be adverse in direction, low in magnitude, regional in geographic extent, seasonal in timing (i.e., winter), frequent in frequency, and long-term in duration (**Table 5.6-6**). Alteration to movement of Fortymile Caribou should be greater in winter when snow management may increase the barrier effect of certain infrastructure (e.g., roads). However, from baseline surveys and collar data to date, movement of Fortymile Caribou does not appear to be notably altered by the presence of roads. The residual cumulative effect of alteration to movement for the FMCH during winter is therefore likely to be a low magnitude effect. The residual cumulative effect is considered partially reversible as the influence of specific projects and associated infrastructure on Caribou movement should decrease following closure and successful reclamation; however, other projects and activities, mainly major highways and other permanent roads, will persist indefinitely, which could permanently alter Caribou movement. However, the likelihood that these features will alter the movement of Fortymile Caribou is unlikely given that collar data suggest movement is occurring across existing highways and roads in the FC-RAA. Mitigation measures (e.g., roadside snow management, seasonal road closures) will further reduce the potential for alteration to movement for Fortymile Caribou. Caribou habituation to roads and other infrastructure that may alter movement is also possible (Johnson and Russell 2014), reducing the potential effect of alteration to movement.

The context for the residual cumulative effect of alteration to movement for Fortymile Caribou is considered high. The herd has tolerated disturbance within their range, such as the Top of the World and Dempster Highways in Yukon, and the Steese and Taylor Highways in Alaska. Satellite collar data indicate that caribou migrate across these highways, which have not prevented the FMCH from expanding their range in Yukon. Furthermore, the FMCH has shown continuous growth since the population low in the 1970s, the herd is not a listed species, and there is currently no hunting of the FMCH, reducing population stresses for the herd. Based on these considerations, the residual cumulative effect of alteration to movement on Fortymile Caribou is considered not significant should not pose a risk to the long-term persistence and viability of the FMCH at the regional level (i.e., FC-RAA). The level of confidence in this determination of significance is moderate based on limited aerial survey and satellite collar data, uncertainty of natural climate regimes (e.g., snow depth), and variable caribou responses to infrastructure and disturbances that may alter movement.

Table 5.6-17 Effect Characteristics Ratings for Fortymile Caribou – Movement

Residual Effect Characteristic	Rating	Rationale for Rating
Direction	Adverse	The effect may alter movement for caribou in the FMCH that interact with development features (e.g., roads).
Magnitude	Low	Collar and survey data demonstrate that Fortymile Caribou already cross existing highways and roads and non-linear discrete features (e.g. mines) should not drastically alter caribou movement. Alteration to movement is unlikely to pose a risk to the long-term persistence and viability of the entire FMCH at the regional level.
Geographic Extent	Regional	The effect would occur within the FC-RAA.
Timing	Seasonal (winter)	The effect would occur in winter between October and April when Fortymile Caribou are present in the FC-RAA.
Frequency	Frequent	The effect is expected to occur frequently (i.e., annually during winter).
Duration	Long-term	The effect is expected to persist over the long-term.
Reversibility	Partially reversible	The effect is expected to be partially reversible as the influence of specific infrastructure and projects on caribou movement should decrease following closure and successful reclamation; however, other infrastructure, such as major highways and other permanent roads will persist indefinitely. It is also possible that caribou may habituate to human activity and infrastructure over time.
Likelihood	Likely	The effect is likely to occur given that a portion of the FMCH is present in the FC-RAA in winter when the potential effects of alteration to movement may be highest (e.g. snow banks impeding movement across roads)

5.6.4.4 Summary of Residual Cumulative Effects and Significance for Fortymile Caribou

Residual cumulative effects, contributing projects and activities, and proposed mitigation measures for Fortymile Caribou are summarized in **Table 5.6-7**. Residual cumulative effects for Fortymile Caribou include habitat loss due to project/activity footprints, reduced habitat effectiveness due to sensory disturbance, increased mortality risk due to collisions with vehicles, and alteration to movement. The residual cumulative effects of habitat loss and reduced habitat effectiveness were assessed as low in magnitude as the total habitat altered was less than the identified threshold of 35%. The residual cumulative effects of increased mortality risk due to collisions with vehicles and alteration to movement were also assessed as low in magnitude. The context for Fortymile Caribou is considered high. Satellite collar data indicate that Fortymile Caribou migrate across major highways in their range (i.e., Top of the World and Dempster highways in Yukon), which suggests the herd is potentially resilient to disturbances. Furthermore, the FMCH has shown continuous population growth since the population low in the 1970s, the herd is not a listed species, and there is currently no hunting of the FMCH, reducing population stresses for the herd. Based on these considerations, the residual cumulative effects on habitat, mortality risk, and alteration to movement were considered not significant and should not pose a risk to the long-term persistence and viability of the FMCH at the regional level (i.e., FC-RAA). The level of confidence in the significance determination for habitat effects was moderate due to limited information on habitat quality and important habitat areas within the FC-RAA, limited information on the expected interaction with anthropogenic and fire disturbances, and uncertainty regarding the spatial and temporal extents of other projects and activities within the FC-RAA. The level of confidence in the significance determination for morality risk was high considering the existing information on caribou mortality associated with vehicle collisions in the FC-RAA and expected effectiveness of mitigation measures to reduce mortality risk. The level of confidence in the significance determination for alteration to movement was moderate based on limited aerial survey and satellite collar data, uncertainty of natural climate regimes (e.g., snow depth), and variable caribou responses to infrastructure and disturbances that may alter movement.

Table 5.6-18 Summary of Residual Cumulative Effects on Fortymile Caribou

Residual Cumulative Effects	Contributing Project and Activities	Proposed Mitigation Measures	Residual Effects Characterization (see Notes for details)										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat Loss and Reduced Habitat Effectiveness	• Quartz exploration • Quartz mining • Placer mining • Settlements • Existing road network • Other surface disturbances	• Project Design • Project Personnel Wildlife Awareness Orientation • Minimize Habitat Disturbance • Wildlife Protection Protocols • Manage Traffic • Manage Aircraft Operations	A	M	Regional	W	L	C	P	L	H	NS	M
Mortality Risk	• Quartz exploration • Quartz mining • Placer mining • Settlements • Existing road network • Other surface disturbances	• Project Design • Project Personnel Wildlife Awareness Orientation • Reduce Human-Wildlife Encounter Risks • Wildlife Protection Protocols • Manage Traffic • Prevent Wildlife Entrapment	A	L	Regional	W	L	I	P	U	H	NS	H

Residual Cumulative Effects	Contributing Project and Activities	Proposed Mitigation Measures	Residual Effects Characterization (see Notes for details)										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Alteration to Movement	• Quartz exploration • Quartz mining • Placer mining • Settlements • Existing road network • Other surface disturbances	• Project Design • Project Personnel Wildlife Awareness Orientation • Manage Traffic • Reduce Barriers to Movement	A	L	Regional	W	L	F	P	L	H	NS	M

Residual Effects Characterization:

Direction: P = Positive, A = Adverse
Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent: Local = Project footprint or ZOI, RAA = Regional, T = Territorial
Timing: Seasonal: (W)inter or (S)ummer, Y= Year-round
Duration: S = Short Term, L = Long-term, P = Permanent
Frequency: I = Infrequent, F = Frequent, C = Continuous
Reversibility: F = Fully Reversible, P = Partially Reversible, I = Irreversible
Likelihood: U = Unlikely, L = Likely
Context: High = H, Moderate = M, L = Low
Significance: NS = Not-Significant, S = Significant
Level of Confidence: H = High, M = Moderate, L = Low

5.6.5 GRIZZLY BEAR SUBCOMPONENT

This section describes residual cumulative effects for Grizzly Bear based on interactions identified in **Table 5.4-1**. Following the successful implementation of mitigation measures described in **Section 5.5**, residual cumulative effects that are expected to remain are habitat loss due to Project footprint and reduced habitat effectiveness due to sensory disturbance. Habitat models produced for the W-RSA during baseline field studies were used for the CEA (Grizzly Bear Habitat Model Report, **Appendix 16-C4**).

5.6.5.1 Habitat Loss and Reduced Habitat Effectiveness

Direct habitat loss and reduced habitat effectiveness for Grizzly Bear was assessed based on the information available for other projects and activities within the W-RAA. A master list of other past, present, and reasonably foreseeable future projects and activities with potential residual adverse effects on Grizzly Bear that could interact with the Project is provided in **Table 5.3-1**. Cumulative habitat loss and reduced habitat effectiveness were assessed following the same methods used for the Project-related effects assessment for Grizzly Bear (**Section 4.4.6**) using models for habitat effectiveness (HE), and security areas, and by using the intersect method for denning habitat. The combined disturbance footprint of all past, present, and reasonably foreseeable future projects and activities that could interact with the Project was used to measure direct habitat loss. Calculation of direct habitat loss for each project/activity category was completed based on the assumptions identified in **Section 5.3**.

- The direct and indirect effects of existing quartz exploration sites, placer projects, future quartz mines, and other surface disturbances was part of the baseline condition scenario analysis in the HE and security areas models. Habitat change is reported as the difference in HE and security areas scenario outputs among the baseline condition, the post-Project and future foreseeable project conditions.
- Future placer activities were not included in the HE and security areas model analyses because it was not possible to predict future placer activity disturbance footprints. This is because the spatial data available is placer claim blocks which contain varying mixtures of pre-existing disturbance and potential future disturbance.
- ZOI — A 500 m ZOI was applied within security areas model analysis and 400 m or 800 m ZOIs were applied within the HE model analysis. These are based on literature specific to methodology in each model (refer to the Grizzly Bear Habitat Model Report**, Appendix 16-C4**).
- Denning habitat — The direct footprint and 1 km ZOI of existing quartz exploration sites, existing and future quartz mines, and other surface disturbances as identified in **Section 5.3** were intersected with suitable denning habitat. Summer-only activities were not included. The amount of overlap of the disturbance areas and the 1 km ZOI with denning habitat is reported as the change in habitat.

The residual cumulative effects of habitat loss and reduced habitat effectiveness were assessed based on the predicted habitat change from the HE, security areas, and denning habitat models. For the HE model, habitat change equals the change in effective green-down and green-up habitat within the W-RAA between scenarios. Reasonably foreseeable future projects and activities (excluding the Project) could affect 0.4% of effective green-down and green-up habitat within the W-RAA (**Table 5.6-19** and **Table 5.6-20**). The Project will contribute to 1.1% of the reduction in habitat effectiveness of green-down and green-up habitat within the W-RAA. The majority of habitat change is attributed to existing disturbance (i.e., realized habitat), which contributes 9% and 8% of the reduced effectiveness of green-down and green-up habitat, respectively.

Security area habitat loss and reduced habitat effectiveness were assessed based on the change in the amount of secure areas within the W-RAA due to past, present and future human disturbance. A total of 2.1% of secure habitat in the W-RAA will be reduced due the Coffee Gold Mine Project and future foreseeable projects (**Table 5.6-21**). The Coffee Gold Mine Project affects 1.8% and future foreseeable projects affect 0.3% of the secure habitat available in the W-RAA.

Habitat loss related to Grizzly Bear denning habitat was assessed based on the amount of suitable denning habitat (i.e., high and moderate-high) within the W-RAA that overlapped with past, present or foreseeable future human disturbance. Footprint and ZOI (1 km) of past and present projects, the Coffee Gold Mine Project, and other future projects overlapped with 10.3% of suitable denning habitat within the W-RAA (**Table 5.6-22**). Existing disturbances affect 9.3% of the suitable denning habitat available in the W-RAA, the Coffee Gold Mine Project will affect an additional 0.2% of the suitable denning habitat available in the W-RAA, and future foreseeable projects will affect 0.8% of the secure habitat available in the W-RAA.

Table 5.6-19 Change in Potential Effective Grizzly Bear Habitat during Green-down due to Cumulative Effects by BMU

BMU	Effective Green-down Habitat				
	Baseline (Realized) Habitat	Habitat Change Compared to Baseline		Total Change	Total Change – Percentage of Baseline
		Coffee Gold Mine	Future Foreseeable Projects		
1	187507	704	1019	1722	0.9%
2	164700	2	0	2	0.0%
3	183171	18	0	18	0.0%
4	246391	1062	0	1062	0.4%
5	244369	48	0	48	0.0%
6	259218	1	0	1	0.0%
7	122283	3693	0	3693	3.0%
8	151577	118	0	118	0.1%
9	138148	2834	0	2834	2.1%
10	146324	9678	0	9678	6.6%
11	128376	2183	0	2183	1.7%
12	148252	0	0	0	0.0%
13	194841	0	0	0	0.0%
14	210683	9134	0	9134	4.3%
15	200396	468	0	468	0.2%
16	146683	5	0	5	0.0%
17	137000	4	0	4	0.0%
18	294772	0	0	0	0.0%
19	186924	-1	0	-1	0.0%
20	160089	687	0	687	0.4%
21	199099	893	0	893	0.4%
22	182811	8195	0	8195	4.5%
23	111702	2	0	2	0.0%
24	141983	0	0	0	0.0%
25	199720	0	0	0	0.0%
26	210109	7637	0	7637	3.6%
27	162113	0	0	0	0.0%
28	185950	7378	17929	25307	13.6%
TOTAL	**5,045,189**	**54,742 (1.1%)**	**18,947 (0.4%)**	**73,689**	**1.5%**

Note: Numbers represent amount of effective habitat in the W-RAA but are not area measurements (unit-less)

Table 5.6-20 Change in Potential Effective Grizzly Bear Habitat during Green-up due to Cumulative Effects by BMU

BMU	Effective Green-up Habitat				
	Baseline (Realized) Habitat	Habitat Change Compared to Baseline		Total Change	Total Change – Percentage of Baseline
		Coffee Gold Mine	Future Foreseeable Projects		
1	100180	346	536	882	0.9%
2	87616	1	0	1	0.0%
3	87000	7	0	7	0.0%
4	116480	499	0	499	0.4%
5	108264	25	0	25	0.0%
6	139180	1	0	1	0.0%
7	59304	1990	0	1990	3.4%
8	79215	47	0	47	0.1%
9	74660	1448	0	1448	1.9%
10	80228	5278	0	5278	6.6%
11	84387	1211	0	1211	1.4%
12	81511	0	0	0	0.0%
13	93050	0	0	0	0.0%
14	108389	4570	0	4570	4.2%
15	96369	191	0	191	0.2%
16	69077	2	0	2	0.0%
17	61507	2	0	2	0.0%
18	150483	0	0	0	0.0%
19	93567	0	0	0	0.0%
20	90858	366	0	366	0.4%
21	103165	429	0	429	0.4%
22	96690	4382	0	4382	4.5%
23	60240	1	0	1	0.0%
24	84954	0	0	0	0.0%
25	103679	0	0	0	0.0%
26	115895	4003	0	4003	3.5%
27	81377	0	0	0	0.0%
28	108577	4583	10485	15068	13.9%
TOTAL	**2,615,902**	**29,381 (1.1%)**	**11,021 (0.4%)**	**40,402**	**1.5%**

Note: Numbers represent amount of effective habitat in the W-RAA but are not area measurements (unit-less)

Table 5.6-21 Change in Potential Effective Grizzly Bear Core Security Zone Habitat due to Cumulative Effects by BMU

BMU	Total Area of Security Habitat in W-RAA (km²)	Habitat Change Compared to Baseline (km²)		Total Change (km²)	Total Change – Percentage of Baseline
		Coffee Gold Mine	Future Foreseeable Projects		
1	517	0.0	0.9	6.1	1.2%
2	371	0.0	0.0	3.3	0.9%
3	448	0.0	0.0	1.1	0.3%
4	612	0.0	0.0	3.5	0.6%
5	563	0.0	0.0	1.4	0.3%
6	628	0.0	0.0	10.3	1.6%
7	367	0.7	0.0	20.0	5.5%
8	429	0.0	0.0	0.2	0.0%
9	376	1.0	0.0	19.9	5.3%
10	374	1.5	0.0	32.2	8.6%
11	470	0.5	0.0	8.6	1.8%
12	391	0.0	0.0	5.6	1.4%
13	387	0.0	0.0	7.4	1.9%
14	507	0.7	0.0	20.0	4.0%
15	420	0.0	0.0	0.8	0.2%
16	328	0.0	0.0	0.0	0.0%
17	470	0.0	0.0	0.0	0.0%
18	621	0.0	0.0	16.9	2.7%
19	389	0.0	0.0	7.3	1.9%
20	455	1.6	0.0	4.8	1.1%
21	443	0.0	0.0	7.6	1.7%
22	459	1.6	0.0	20.6	4.5%
23	490	0.0	0.0	4.9	1.0%
24	453	0.0	0.0	6.2	1.4%
25	478	0.0	0.0	2.6	0.5%
26	585	17.1	0.0	24.1	4.1%
27	379	0.0	0.0	0.1	0.0%
28	520	0.0	38.1	41.3	7.9%
TOTAL	**12,933**	**24.7 (1.8%)**	**39.0 (0.3%)**	**276.8**	**2.1%**

Table 5.6-22 Area of Cumulative Effects on Suitable Grizzly Bear Denning Habitat by BMU

BMU	Total Area of Suitable Denning Habitat in W-RAA	Change in Denning Habitat (km^2)				
		Existing Projects and Activities	Coffee Gold Mine	Other Future Projects	Total Change	Proportion of Potential
	km²	km²	km²	km²	km²	%
1	36.0	23.0	2.1	<0.1	25.1	70%
2	30.3	7.3	0.0	0	7.3	24%
3	29.5	7.8	<0.1	0	7.8	26%
4	68.6	19.2	4.5	0	23.7	35%
5	21.2	7.1	0.1	0	7.2	34%
6	56.9	1.5	0.0	0	1.5	3%
7	19.1	3.4	3.2	0	6.6	35%
8	36.4	0.9	0.0	0	0.9	2%
9	35.8	5.4	1.6	0	7.0	20%
10	42.7	2.6	4.3	0	6.9	16%
11	48.5	7.2	0.8	0	8.0	16%
12	30.6	0.0	0.0	0	0.0	0%
13	24.2	1.0	0.0	0	1.0	4%
14	40.7	3.5	1.9	0	5.4	13%
15	27.4	0.0	0.0	0	0.0	0%
16	26.3	0.0	0.0	0	0.0	0%
17	34.9	0.0	0.0	0	0.0	0%
18	68.5	1.3	0.0	0	1.3	2%
19	38.5	<0.1	0.0	0	<0.1	0%
20	47.8	<0.1	0.1	0	0.1	0%
21	76.0	12.9	0.9	0	13.8	18%
22	77.0	3.6	4.8	<0.1	8.4	11%
23	63.0	0.0	0.0	0	0.0	0%
24	63.8	<0.1	0.0	0	<0.1	0%
25	63.5	0.0	0.0	0	0.0	0%
26	75.5	0.2	9.4	0	9.6	13%
27	40.2	0.0	0.0	0	0.0	0%
28	86.7	13.3	0.0	10.4	23.7	27%
TOTAL	**1,309.3**	**121.2 (9.3%)**	**2.8 (0.2%)**	**10.4 (0.8%)**	**165**	**13%**

As there is no prescribed threshold for habitat effectiveness available, other jurisdictions in North America have adopted a threshold of 80% habitat effectiveness. Below this threshold, Grizzly Bear use of an area declines (Parks Canada 1997, as cited in AXYS 2001). In the absence of regulatory guidance for the establishment of quantitative thresholds of security habitat for Grizzly Bear, a significance threshold of 65% within each BMU area will be applied. Jasper National Park adopted a minimum threshold for security areas of 60 to 67% secure within each BMU (H. Purves, Pers. Comm. as cited in AXYS 2001). Overall, 90% of green-down and green-up habitat effectiveness remains and 96% of security areas remain intact in the W-RAA given the potential combined effects of past, present and future foreseeable projects. Change to suitable denning habitat may be reduced up to 13%. This includes all suitable habitat within 1 km of disturbance footprint which overestimates habitat change because it assumes all habitat within the ZOI is reduced to zero suitability. The results are well within the adopted thresholds for habitat effectiveness and security habitat for Grizzly Bear and overall fit within the low magnitude threshold set for the Project effects assessment (**Section 4.4.1**).

The residual cumulative effects of the Project and other projects and activities on Grizzly Bear habitat loss and reduced habitat effectiveness will be adverse in direction, low in magnitude, regional in geographic extent, long-term in duration (but not permanent), and infrequent in occurrence (**Table 5.6-23**). Effects are considered partially reversible as some of the disturbed habitat could be reclaimed when projects or activities are completed, and the literature shows that once traffic or activity events are reduced, Grizzly Bears avoid the disturbance to a lesser degree. The probability of occurrence is likely as Grizzly Bears and potential Grizzly Bear habitat are known to occur in the W-RAA. The context for Grizzly Bear is high considering that a large amount of secure habitat and effective habitat exists compared to suggested thresholds. Hunting is regulated and human-caused mortality of Grizzly Bears is low considering available data. The Project and future foreseeable projects contribute a small degree to the overall change in habitat effectiveness and security areas related to existing disturbance in focused locations within the W-RAA.

The cumulative effect on Grizzly Bear habitat is considered not significant and should not pose a risk to the long-term persistence and viability of Grizzly Bears at the regional level. The level of confidence in the significance determinations is moderate due to the following:

- Known occurrence of Grizzly Bear and potential effective habitat within the W-RAA coupled with habitat modelling based on existing data provides a reasonable basis to predict habitat changes.
- Denning habitat model is at a coarse resolution and it is not practicable to predict microsite denning feature potential.
- There is uncertainty regarding the spatial and temporal extents of future foreseeable projects and activities within the W-RAA.

Table 5.6-23 Cumulative Effect Characteristics Ratings for Grizzly Bear Habitat

Residual Cumulative Effects Characteristic	Rating	Rationale for Rating
Direction	Adverse	The effect would result in direct habitat loss and reduced habitat effectiveness due to project/activity footprints.
Magnitude	Low	The magnitude of the effect was assessed as low based on the level of change to effective habitat and security areas compared to thresholds for these Grizzly Bear habitat requisites.
Geographic Extent	RAA	The effect would occur at the regional level.
Timing	Year-round	Grizzly Bear are present year-round. Denning takes place from October to April.
Frequency	Infrequent	The majority of the 299 quartz and placer projects within the W-RAA are currently active. Only two additional quartz mines are proposed. Habitat loss would occur relatively infrequently. Most of these projects would likely be limited in spatial extent, located in areas that have already been previously disturbed, and/or occur on a seasonal basis.
Duration	Long-term	The direct loss of habitat would be a long-term loss.
Reversibility	Partially reversible	Some of the disturbed habitat could be reclaimed when projects or activities are completed and disturbance related to road use will subside once projects are inactive. Some disturbance (e.g., primary roads and highways) are expected to persist indefinitely.
Likelihood	Likely	Change to habitat has already occurred or is currently occurring due to a number of other projects and activities operating within the W-RAA. Future projects are currently planned and will likely result in habitat change.

5.6.5.2 Summary of Residual Cumulative Effects and Significance for Grizzly Bear

The CEA for Grizzly Bear considered interactions between the Project and other projects and activities within the W-RAA that may result in adverse cumulative residual effects for Grizzly Bear. The projects and activities considered in the CEA included quartz projects, placer projects, and existing roads within the W-RAA. Following the successful implementation of mitigation measures described in **Section 5.5**, change to habitat including direct habitat loss and reduced habitat effectiveness are adverse cumulative residual effects for Grizzly Bear within the W-RAA. The residual effect is low in magnitude based on predicted total change in habitat effectiveness green-down, green-up, security areas, and denning. The context for Grizzly Bear is high because the Project and the future foreseeable projects overlap with existing disturbance which is the primary driver of the habitat change from baseline conditions, and human-caused mortality is expected to continue to be at low levels in the region. Cumulative residual effects for Grizzly Bear were rated as not significant (**Table 5.6-24**). The level of confidence in the effects predictions and significance determinations is moderate due to uncertainty regarding detailed knowledge of Grizzly Bear density and habitat use within the W-RAA and uncertainty regarding the spatial and temporal extents of other projects and activities within the W-RAA.

Table 5.6-24 Summary of Residual Cumulative Effects on Grizzly Bear

Residual Cumulative Effects	Contributing Projects and Activities	Proposed Mitigation Measures	Residual Effects Characterization (see Notes for details)										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat Loss and Reduced Habitat Effectiveness	• Quartz exploration • Quartz mining • Placer mining • Settlements • Existing road network • Other surface disturbances	• Project Design • Project Personnel Wildlife Awareness Orientation • Minimize Habitat Disturbance • Wildlife Protection Protocols • Manage Traffic • Manage Aircraft Operations	A	L	Regional	Y	L	I	P	L	H	NS	M

Residual Effects Characterization:

Direction: P = Positive, A = Adverse
Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent: Local = Project footprint or ZOI, RAA = Regional, T = Territorial
Timing: Seasonal: (W)inter or (S)ummer, Y= Year-round
Duration: S = Short Term, L = Long-term, P = Permanent
Frequency: I = Infrequent, F = Frequent, C = Continuous
Reversibility: F = Fully Reversible, P = Partially Reversible, I = Irreversible
Likelihood: U = Unlikely, L = Likely
Context: High = H, Moderate = M, L = Low
Significance: NS = Not-Significant, S = Significant
Level of Confidence: H = High, M = Moderate, L = Low

5.6.6 WOLVERINE SUBCOMPONENT

This section describes residual cumulative effects for Wolverine based on interactions identified in **Table 5.4-1**. Following the successful implementation of the mitigation measures described in **Section 5.5**, two residual cumulative effects are expected to remain: habitat loss due to project/activity footprints and reduced habitat effectiveness due to sensory disturbance. The denning habitat model produced for the Wildlife RSA during baseline field studies was used for the CEA (refer to **Section 4.4.8** and the Wolverine Denning Habitat Model Report **Appendix 16-C5**).

5.6.6.1 Habitat Loss and Reduced Habitat Effectiveness

Direct habitat loss for Wolverine was estimated based on the information available for other projects and activities within the W-RAA. A master list of other past, present, and reasonably foreseeable future projects and activities with potential residual adverse effects on Wolverine that could interact with the Project is provided in **Table 5.3-1**. Cumulative habitat loss and reduced habitat effectiveness were assessed following the same methods used for the Project-related effects assessment for Wolverine (**Section 4.4.8**). The combined disturbance footprint of all past, present, and reasonably foreseeable future projects and activities that could interact with the Project was used to measure direct habitat loss.

Calculation of direct habitat loss for each project/activity category was completed based on the assumptions identified in **Section 5.3**. The assumed footprint sizes are conservative to capture the scenario with the largest spatial extent for residual cumulative effects; it is unlikely that all quartz and placer projects would operate to these extents during the life of the Project. Furthermore, the likelihood of these projects occurring consecutively and year-round with the Project is unknown; however, based on mining history in Yukon, consecutive operation is unlikely. A ZOI approach was used to determine reduced habitat effectiveness due to sensory disturbance and included a 5 km ZOI around the Project mine site area and quartz mines and a 1 km ZOI along the NAR and other surface disturbances. A ZOI was not included around quartz exploration sites or placer projects because these activities occur during summer; therefore, sensory disturbance will not be an issue during winter when Wolverine may be denning.

The residual cumulative effects of habitat loss and reduced habitat effectiveness on Wolverine denning habitat were assessed based on the amount of potential denning habitat (i.e., high and moderate-rated) within the W-RAA. Given the assumptions identified above, past, present, and reasonably foreseeable future projects and activities (excluding the Project) could directly affect 1.15% (14.57 km²) of potential denning habitat within the W-RAA (**Table 5.6-25**). The Project will contribute an additional 0.70% (8.89 km²) to direct habitat loss within the W-RAA). An additional 10.52% (133.44 km²) of potential denning habitat within the ZOIs (excluding the Project) could experience reduced habitat effectiveness due to sensory disturbance. The Project ZOI will contribute an additional 7.82% (99.25 km²) to reduced habitat effectiveness within the W-RAA. The combined cumulative effects of habitat loss and reduced habitat effectiveness on Wolverine denning habitat could alter up to 20.19% of potential denning habitat within the W-RAA, which exceeds the 15% habitat disturbance threshold described in **Section 4.4.1**.

Table 5.6-25 Cumulative Habitat Loss and Reduced Habitat Effectiveness for Wolverine

Total Area of Potential Denning Habitat in W-RAA	Existing / Future Projects and Activities		Coffee Gold Mine Project		Total Habitat Altered
	Habitat Loss	Reduced Habitat Effectiveness	Habitat Loss	Reduced Habitat Effectiveness	
km^2	km^2 (%)	km^2 (%)	km^2 (%)	km^2 (%)	km^2 (%)
1269.00	14.57 (1.15)	133.44 (10.52)	8.89 (0.70)	99.25 (7.82)	256.15 (20.19)

Note: To avoid double-counting, areas of the Coffee Gold Mine Project that overlap existing and future disturbances are included under the habitat loss and reduced habitat effectiveness for the Coffee Gold Mine Project.

The residual cumulative effects of the Project and other projects and activities on potential Wolverine denning habitat will likely be adverse in direction, high in magnitude, regional in geographic extent, seasonal in timing (i.e., winter), continuous in frequency, and long-term in duration (**Table 5.6-26**). The residual cumulative effects are considered partially reversible as some of the disturbed habitats could be reclaimed when projects or activities are completed, while other disturbed habitats (e.g., primary roads and highways) are expected to persist indefinitely. The likelihood of the residual cumulative effects occurring is considered unlikely. The denning habitat model uses the presence of late spring snow cover to identify suitable denning habitat; however, the areas mapped are only potential denning habitat and it is unlikely that all of these areas will contain the discrete habitat features necessary to support Wolverine denning sites. The approach is conservative and likely over-estimates the amount of potential denning habitat that might be altered by the Project and other projects and activities within the W-RAA. The context for Wolverine is considered moderate as Wolverine are a species of 'special concern' by COSEWIC (2014), however, Yukon contains a high proportion of Canada's estimated Wolverine population and densities in Yukon are some of the highest reported in North America. Based on these considerations, the residual cumulative effects on habitat were considered not significant and should not pose a risk to the long-term persistence and viability of the Wolverine population at the regional level (i.e., W-RAA). The level of confidence in the significance determination is moderate due to the coarse scale of habitat mapping for Wolverine within the W-RAA and uncertainty regarding the spatial and temporal extents of other projects and activities within the W-RAA.

Table 5.6-26 Cumulative Effect Characteristics Ratings for Wolverine Habitat

Residual Cumulative Effects Characteristic	Rating	Rationale for Rating
Direction	Adverse	The direct or indirect loss of potential denning habitat would be adverse.
Magnitude	High	The estimated loss of potential denning habitat within the W-RAA due to the Coffee Mine Project and other project/activity footprints and sensory disturbances would be 20.19%.
Geographic Extent	Regional	The effect would occur at the regional level.
Timing	Seasonal (winter)	Denning takes place from late winter to early spring.
Frequency	Continuous	Potential denning habitat would be affected over the life of the Project (i.e., 20 years).
Duration	Long-term	Potential denning habitat would be affected over the life of the Project (i.e., 20 years).
Reversibility	Partially reversible	Some of the disturbed habitat could be reclaimed when projects or activities are completed, while other projects and activities (e.g., primary roads and highways) are expected to persist indefinitely.
Likelihood	Unlikely	The denning habitat model predicts potential denning habitat based on late spring snow cover; however, the areas mapped are only potential denning habitat and it is unlikely that all of these areas will contain the discrete habitat features necessary to support Wolverine denning sites.

5.6.6.2 Summary of Residual Cumulative Effects and Significance for Wolverine

Residual cumulative effects, contributing projects and activities, and proposed mitigation measures for Wolverine are summarized in **Table 5.6-27**. Residual cumulative effects for Wolverine include habitat loss due to project/activity footprints and reduced habitat effectiveness due to sensory disturbance. The residual cumulative effect of habitat loss and reduced habitat effectiveness was assessed as high in magnitude as the total habitat altered was >15%. The denning habitat model uses the presence of late spring snow cover to identify suitable denning habitat; however, the areas mapped are only potential denning habitat and it is unlikely that all of these areas will contain the discrete habitat features necessary to support Wolverine denning sites. As such, the approach is conservative and likely over-estimates the amount of potential denning habitat that might be altered by the Project and other projects and activities within the W-RAA. The context for Wolverine was considered moderate as Wolverine are a species of 'special concern' by COSEWIC (2014), however, Yukon contains a high proportion of Canada's estimated Wolverine population and densities in Yukon are some of the highest reported in North America. Based on these considerations, the residual cumulative effects on habitat were considered not significant and should not pose a risk to the long-term persistence and viability of the Wolverine population at the regional level (i.e., W-RAA). The level of confidence in the significance determination is moderate due to the coarse scale of habitat mapping for Wolverine within the W-RAA and uncertainty regarding the spatial and temporal extents of other projects and activities within the W-RAA.

Table 5.6-27 Summary of Residual Cumulative Effects on Wolverine

Residual Cumulative Effects	Contributing Projects and Activities	Proposed Mitigation Measures	Residual Effects Characterization (see Notes for details)										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat Loss and Reduced Habitat Effectiveness	• Quartz exploration • Quartz mining • Placer mining • Settlements • Existing road network • Other surface disturbances	• Project Design • Project Personnel Wildlife Awareness Orientation • Minimize Habitat Disturbance • Wildlife Protection Protocols • Manage Traffic • Manage Aircraft Operations	A	H	Regional	W	L	C	P	U	M	NS	M

Residual Effects Characterization:

Direction: P = Positive, A = Adverse
Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent: Local = Project footprint or ZOI, RAA = Regional, T = Territorial
Timing: Seasonal: (W)inter or (S)ummer, Y= Year-round
Duration: S = Short Term, L = Long-term, P = Permanent
Frequency: I = Infrequent, F = Frequent, C = Continuous
Reversibility: F = Fully Reversible, P = Partially Reversible, I = Irreversible
Likelihood: U = Unlikely, L = Likely
Context: High = H, Moderate = M, L = Low
Significance: NS = Not-Significant, S = Significant
Level of Confidence: H = High, M = Moderate, L = Low

5.6.7 LITTLE BROWN MYOTIS SUBCOMPONENT

This section describes residual cumulative effects for Little Brown Myotis based on interactions identified in **Table 5.4-1**. Following the successful implementation of the mitigation measures described in **Section 5.5**, two residual cumulative effects are expected to remain: habitat loss due to project/activity footprints and reduced habitat effectiveness due to sensory disturbance. The CEA examines the cumulative effects of habitat loss and reduced habitat effectiveness within the W-RAA and uses old forest (i.e., >130 years old) below 1,000 m elevation as a surrogate for potential Little Brown Myotis roosting habitat. Important roosting habitat includes cliff areas, rock complexes, caves, and old forest.

5.6.7.1 Habitat Loss and Reduced Habitat Effectiveness

Direct habitat loss for Little Brown Myotis was estimated based on the information available for other projects and activities within the W-RAA. A master list of other past, present, and reasonably foreseeable future projects and activities with potential residual adverse effects on Little Brown Myotis that could interact with the Project is provided in **Table 5.3-1**. Cumulative habitat loss and reduced habitat effectiveness were assessed following the same methods used for the Project-related effects assessment for Little Brown Myotis (**Section 4.4.9**). The combined disturbance footprint of all past, present, and reasonably foreseeable future projects and activities that could interact with the Project was used to measure direct habitat loss. Calculation of direct habitat loss for each project/activity category was completed based on the assumptions identified in **Section 5.3**. A 100 m ZOI around all old forest polygons below 1,000 m elevation was used to assess reduced habitat effectiveness due to sensory disturbance.

The residual cumulative effects of habitat loss and reduced habitat effectiveness on Little Brown Myotis roosting habitat were assessed based on the amount of potential roosting habitat (i.e., old forest >130 years old below 1,000 m elevation) within the W-RAA. Given the assumptions identified above, past, present, and reasonably foreseeable future projects and activities (excluding the Project) could directly affect 4.04% (12.43 km^2) of potential roosting habitat within the W-RAA (**Table 5.6-28**). The Project will contribute 0.19% (0.59 km^2) of direct habitat loss within the W-RAA. An additional 1.29% (3.96 km^2) of potential roosting habitat within the ZOI (excluding the Project) could experience reduced habitat effectiveness within the W-RAA. The Project will add an additional 0.38% (1.18 km^2) to reduced habitat effectiveness within the W-RAA. The combined cumulative effects of habitat loss and reduced habitat effectiveness on Little Brown Myotis roosting habitat could alter up to 5.90% of potential roosting habitat within the W-RAA, which is within the low magnitude habitat disturbance threshold described in **Section 4.4.1**.

Table 5.6-28 Cumulative Habitat Loss and Reduced Habitat Effectiveness for Little Brown Myotis

Total Area of Potential Roosting Habitat in W-RAA	Existing / Future Projects and Activities		Coffee Gold Mine Project		Total Habitat Altered
	Habitat Loss	Reduced Habitat Effectiveness	Habitat Loss	Reduced Habitat Effectiveness	
km²	km² (%)	km² (%)	km² (%)	km² (%)	km² (%)
307.90	12.43 (4.04)	3.96 (1.29)	0.59 (0.19)	1.18 (0.38)	18.16 (5.90)

Notes: The W-RAA, ZOI, and footprint include areas below 1,000 m elevation only.

To avoid double-counting, habitat loss and reduced habitat effectiveness for the Coffee Gold Mine Project only include areas of new disturbance. Areas of the Coffee Gold Mine Project that overlap existing disturbances are included under existing/future projects and activities.

The residual cumulative effects of the Project and other projects and activities on Little Brown Myotis roosting habitat will likely be adverse in direction, low in magnitude, regional in geographic extent, seasonal in timing (i.e., summer), continuous in frequency, and long-term in duration (**Table 5.6-29**). The residual cumulative effects are considered partially reversible as some of the disturbed habitats could be reclaimed when projects or activities are completed, while other disturbed habitats (e.g., primary roads and highways) are expected to persist indefinitely. The likelihood of the residual cumulative effects occurring is considered unlikely. Old forest (i.e., >130 years old) below 1,000 m elevation was used as a surrogate for potential Little Brown Myotis roosting habitat; however, the areas mapped are only potential roosting habitat and it is unlikely that all of these areas will contain the discrete habitat features (i.e., roost trees) to support roosting bats. As such, the approach is conservative and likely over-estimates the amount of potential roosting habitat that might be cumulatively altered by the Project and other projects and activities within the W-RAA. The context for Little Brown Myotis is moderate considering their Endangered SARA-listing and the current threat of White-nose Syndrome on bats; however, the disease is not believed to have expanded into Yukon bat populations yet (COSEWIC 2013). Based on these considerations, the residual cumulative effects on habitat were considered to be not significant and should not pose a risk to the long-term persistence and viability of the Little Brown Myotis population at the regional level (i.e., W-RAA). The level of confidence in the significance determination is moderate due to the following:

- Uncertainty regarding the exact size and state of the Little Brown Myotis population within the W-RAA
- Coarse scale of habitat mapping for Little Brown Myotis within the W-RAA
- Uncertainty regarding the spatial and temporal extents of other projects and activities within the W-RAA.

Table 5.6-29 Cumulative Effect Characteristics Ratings for Little Brown Myotis Habitat

Residual Cumulative Effects Characteristic	Rating	Rationale for Rating
Direction	Adverse	The loss of potential roosting habitat would be adverse.
Magnitude	Low	The estimated loss of potential roosting habitat within the W-RAA due to the Coffee Mine Project and other existing and future project footprints and sensory disturbances would be 5.90%.
Geographic Extent	Regional	The effect would occur at the regional level.
Timing	Seasonal (summer)	Bats are typically present in Yukon from April to September.
Frequency	Continuous	Potential denning habitat would be affected over the life of the Project (i.e., 20 years).
Duration	Long-term	Potential denning habitat would be affected over the life of the Project (i.e., 20 years).
Reversibility	Partially reversible	Some of the disturbed habitat could be reclaimed when projects or activities are completed, while other projects and activities (e.g., primary roads and highways) are expected to persist indefinitely.
Likelihood	Unlikely	Old forest (i.e., >130 years old) below 1,000 m elevation was used as a surrogate for potential roosting habitat; however, the areas mapped are only potential roosting habitat and it is unlikely that all of these areas will contain the discrete habitat features (i.e., roost trees) to support roosting bats.

5.6.7.2 Summary of Residual Cumulative Effects and Significance for Little Brown Myotis

Residual cumulative effects, contributing projects and activities, and proposed mitigation measures for Little Brown Myotis are summarized in **Table 5.6-30**. Residual cumulative effects for Little Brown Myotis include habitat loss due to project/activity footprints and reduced habitat effectiveness due to sensory disturbance. The residual cumulative effect of habitat loss and reduced habitat effectiveness was assessed as low in magnitude as the total habitat altered was less than 10% of the habitat within the W-RAA. Old forest (i.e., 130 years old) below 1,000 m elevation was used as a surrogate for potential Little Brown Myotis roosting habitat; however, the areas mapped are only potential roosting habitat and it is unlikely that all of these areas will contain the discrete habitat features (i.e., roost trees) to support roosting bats. As such, the approach is conservative and likely over-estimates the amount of potential roosting habitat that might be altered by the Project and other projects and activities within the W-RAA. The context for Little Brown Myotis is moderate considering their Endangered SARA-listing and the current threat of White-nose Syndrome on bats; however, the disease is not believed to have expanded into Yukon bat populations yet (COSEWIC 2013). Based on these considerations, the residual cumulative effects on habitat were considered to be not significant and should not pose a risk to the long-term persistence and viability of the Little Brown Myotis population at the regional level (i.e., W-RAA). The level of confidence in the significance determination is moderate due to the following:

- Uncertainty regarding the exact size and state of the Little Brown Myotis population within the W-RAA.
- Coarse scale of habitat mapping for Little Brown Myotis within the W-RAA.
- Uncertainty regarding the spatial and temporal extents of other projects and activities within the W-RAA.

Table 5.6-30 Summary of Residual Cumulative Effects on Little Brown Myotis

Residual Cumulative Effects	Contributing Projects and Activities	Proposed Mitigation Measures	Residual Effects Characterization (see Notes for details)										
			Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Likelihood	Context	Significance	Level of Confidence
Habitat Loss and Reduced Habitat Effectiveness	• Quartz exploration • Quartz mining • Placer mining • Settlements • Existing road network • Other surface disturbances	• Project Design • Project Personnel Wildlife Awareness Orientation • Minimize Habitat Disturbance • Wildlife Protection Protocols • Manage Traffic • Manage Aircraft Operations	A	L	Regional	S	L	C	P	U	M	NS	M

Residual Effects Characterization:

Direction: P = Positive, A = Adverse
Magnitude: L = Low magnitude, M = Moderate magnitude, H = High magnitude
Geographic Extent: Local = Project footprint or ZOI, RAA = Regional, T = Territorial
Timing: Seasonal: (W)inter or (S)ummer, Y= Year-round
Duration: S = Short Term, L = Long-term, P = Permanent
Frequency: I = Infrequent, F = Frequent, C = Continuous
Reversibility: F = Fully Reversible, P = Partially Reversible, I = Irreversible
Likelihood: U = Unlikely, L = Likely
Context: High = H, Moderate = M, L = Low
Significance: NS = Not-Significant, S = Significant
Level of Confidence: H = High, M = Moderate, L = Low

6.0 SUMMARY OF EFFECTS ASSESSMENT ON WILDLIFE AND WILDLIFE HABITAT

Wildlife and Wildlife Habitat were selected as a VC because of potential Project-related effects on individuals, populations, and habitats. Wildlife are important because of their value to First Nations and other local people who may rely on certain species as a subsistence and economic resource, and for their value representing biodiversity. Wildlife and their associated habitats are also important because some species are identified as species at risk and must be assessed where potential Project-related effects can occur (SARA, subsection 79).

The Fortymile Caribou herd, Klaza Caribou herd, Moose, Thinhorn Sheep, Grizzly Bear, Wolverine, and Little Brown Myotis were selected to represent the likely range of potential Project-related effects on Wildlife and Wildlife Habitat. These species were selected for a variety of reasons including SARA or COSEWIC designations (i.e., species at risk), a clear interaction with the Project footprint, sensitivity to disturbance, specific habitat requirements, cultural importance, identification in engagement meetings, or otherwise documented as a concern.

The assessment of potential Project-related effects and the significance of those effects on Wildlife and Wildlife Habitat was conducted at the regional level (i.e., RAA). Potential Project-related effects included habitat loss due to the Project footprint, reduced habitat effectiveness of adjacent habitat due to sensory disturbance (e.g., noise, movement, dust), mortality risk, alteration to movement, and potential for contaminants uptake. To mitigate the habitat loss, disturbance within the Project footprint will be minimized, existing roads will be used, and habitat features (e.g., mineral licks, dens, bat roosts) will be protected via the establishment of appropriate no-disturbance setback distances. To mitigate reduction in habitat effectiveness, traffic will be minimized and all roads will have speed limits of 50 km/hour. Management of traffic will also mitigate mortality risk caused by vehicle collisions. Mortality risk due to wildlife-human interactions will be mitigated through Project design such as waste management measures and mortality risk due to indirectly facilitating hunting will be mitigated through wildlife protection protocols for mine personnel. Alteration of movement will be mitigated by constructing wildlife crossings where necessary, managing snow banks for wildlife, and minimizing road embankment profiles. Potential for contaminant uptake will be mitigated by limiting pathways for the effect and installing barriers if needed around sources of potential contaminant uptake. A mitigation measure that will be applicable to minimizing all potential effects is that all site personnel will be required to participate in a Wildlife Awareness Orientation, and a wildlife sighting log will be maintained throughout all phases of the Project. Effectiveness of mitigation will be periodically monitored throughout the Project as described in the WPP (**Appendix 31-F**). Adaptive management measures will be implemented if mitigation is not effective.

Following the successful application of these mitigation measures, Project-related residual effects for all subcomponents are anticipated to occur for habitat loss and reduced habitat effectiveness due to sensory disturbance. Potential Project-related residual effects on Fortymile Caribou, Klaza Caribou, Moose and Grizzly Bear include mortality risk, and alteration to movement is a potential residual effect on Fortymile Caribou and Sheep. No significant effects were identified for any of the subcomponents at the regional level. Although a residual effect might occur at the individual level if Project-related activities resulted in habitat loss and reduced habitat effectiveness due to sensory disturbance, and to mortality risk and altered movement to some subcomponents, the effect would be unlikely to pose a risk to the long-term persistence and viability of the entire Wildlife population at the regional level. Thus, all residual effects were assessed to be not significant.

Residual cumulative effects due to interactions with other projects and activities were assessed for the Project at the scale of the RAA. Project-related residual effects considered habitat loss due to project and other activity footprints and reduced habitat effectiveness due to sensory disturbance (e.g., noise, movement, dust). Mortality risk and alteration to movement was considered for select species. The projects and activities considered in the CEA included quartz projects, placer projects, and existing disturbance including road networks. These projects and activities were selected based on their potential to interact cumulatively with other projects and activities within the RAA, including the Project. Cumulative effects assessments were completed for each subcomponent using methods consistent with the Project-specific effects assessments. Reduction of habitat was under thresholds used to determine the significance of residual effects in all cases. Mortality risk and alteration to movement were also not significant in the cumulative effects assessment. The effects would be unlikely to pose a risk to the long-term persistence and viability of the entire wildlife population at the regional level given the additive effects of past, present and reasonably foreseeable future projects. All cumulative effects were assessed to be Not Significant.

The CEA predictions are based on several assumptions and represent a conservative approach. It is unlikely that all quartz projects would operate to the same spatial extent as the Project during the life of the Project. The estimated project footprint for each placer footprint (each entire placer claim) is also conservative and may over-represent the area actually affected. Furthermore, the likelihood of these projects occurring consecutively and year-round with the Project is unknown; however, based on mining history in Yukon, consecutive operation is unlikely. Detailed ecosystem mapping is not available for the entire RAA, which was one factor that limited the level of confidence in the determination of the significance of residual effects.

Although there will be a cumulative loss of wildlife habitat within the RAAs via habitat loss and reduced habitat effectiveness, this could be partially reversed following successful reclamation of disturbed areas. The cumulative loss of habitat in areas that cannot be fully reclaimed could be mitigated by the collective actions of individual project proponents, which could include minimizing/mitigating disturbances to Wildlife and Wildlife Habitat and reclaiming key habitat areas if they are disturbed by project activities.

Potential residual effects due to accidents or malfunctions were also assessed for the Project. An accident is an unexpected occurrence or unintended action that may cause an adverse environmental effect. A malfunction is the failure of a piece of equipment, device, or system to function as intended, which may also cause an adverse environmental effect. Accidents or malfunctions may occur during any phase of the Project. The objective of the Proponent is to minimize the likelihood of accidents or malfunctions and the associated consequences that might affect Wildlife and Wildlife Habitat. Potential accident and malfunction scenarios that may interact with, and result in potential adverse effects to, Wildlife and Wildlife Habitat include the following: a hazardous material spill into water (i.e., cyanide or diesel fuel); a release of off-specification effluent into a watercourse; failure of the HLF and corresponding release of cyanide-contaminated water into the downstream receiving environment; failure of a waste rock storage facility and stockpile slope, which could lead to acid rock drainage and metal leaching into the downstream receiving environment; and an on-site or off-site fire or explosion leading to a stand-replacing wildfire at the regional level. Although these potential scenarios could have major or severe consequences (i.e., significant residual effects) for Wildlife and Wildlife Habitat, particularly if they occur during the spring and/or fall when the dilution capacity in rivers would be lowest, the probability of occurrence is unlikely following the successful implementation of Project design measures, BMPs, and mitigation measures intended to minimize the risk of potential accidents or malfunctions.

7.0 EFFECTS MONITORING AND ADAPTIVE MANAGEMENT

Although the effects of the Project will be minimized by mitigation measures described in **Section 4.3**, where the effects assessment findings are based on limited data, there is uncertainty in the predictions or the potential exists for a significant residual effect, monitoring programs will provide a means to gain certainty in predicted Project-related effects and determine the effectiveness of mitigation measures. The objectives of the Project's monitoring program framework include the following:

- Monitor Wildlife use of the Project area
- Monitor and verify potential effects related to the Project
- Monitor and evaluate the effectiveness of mitigation measures
- Identify unanticipated Project effects
- Discern Project-related changes from natural variability
- Inform adaptive management measures.

The monitoring and adaptive management approach is fully described in the WPP (**Appendix 31-F**). This section identifies the main components of the effects monitoring relevant to Wildlife.

The monitoring programs will address differing information needs, from evaluating effects directly related to the Project, to evaluating Wildlife interactions with Project infrastructure, to addressing the Proponent's commitments to supporting broader baseline information needs on Wildlife in the region. Wildlife monitoring programs will include both general monitoring (also referred to as facility-specific monitoring) looking at potential Project interactions with multiple species, and more specific monitoring targeting indicator species or effects.

Indicator species/effect monitoring will increase knowledge regarding Wildlife occurrence within the Project area and monitor potential Project-Wildlife interactions to validate Project effects assessment findings. The following indicator species/effect monitoring programs will be developed for the Project:

- Caribou
- Moose
- Thinhorn Sheep
- Wolf Road Use

In addition, several other indicator species/effects monitoring programs may also be developed if necessary, including, but not limited to:

- Mineral Lick monitoring — baseline surveys to date have not located any active mineral licks within 500 m of the Project footprint. If a mineral lick were to be identified in this area, a specific monitoring program would be developed.

7.1 General Project Monitoring — All Species

Project infrastructure, including both the Mine Site and the NAR, and activities associated with these facilities pose potential risks to Wildlife and obstacles to Wildlife movement. **Table 8.1-1** provides a general summary of the Project component-specific monitoring programs detailed in the WPP (**Appendix 31-F**).

Table 8.1-1 Summary of General Project Monitoring Related to Wildlife

Monitoring Component	Frequency	Description
Mine Site Footprint/ Habitat Loss Monitoring	Annual	The Proponent will monitor and annually review the amount of Wildlife habitat (i.e., vegetation communities) lost to the Mine Site footprint. Comparisons will be made between the planned footprint in the Project description and the actual footprint mapped using a GPS. This will quantify direct habitat loss in the Project footprint.
Building Assessment	Monthly	The Proponent will check Mine Site infrastructure for use by nest predators (e.g. foxes, ravens, etc.), nesting structures, or as a haven for potential problem Wildlife.
Project Activity Monitoring	Ongoing	The Proponent will track activities levels at the mine including human presence (e.g., man days), construction and operational activities, blasting activities etc.
Traffic Monitoring along Northern Access Route	Ongoing	The Proponent will monitor project-related traffic volumes along the NAR. These levels will be compared to baseline traffic volumes along the road.
Waste Management	Monthly	The Proponent Environmental Department will conduct regular surveillance of Project facilities and waste disposal sites to ensure that Wildlife are not frequenting these areas. Additionally, the Environmental Department will perform audits periodically to assess the effectiveness of waste management practices.
Wildlife Observations	Ongoing	As discussed in **Section 6.2.1**, employees and contractors will be required to report all Wildlife sightings along the road and near Project facilities. The Proponent will track all reported Wildlife observations; data collected will include location, date, time, species, activity, etc.
Project-related Mortality	Ongoing	The Proponent will document and track all near misses, collisions, and other observed Wildlife mortalities within the Project area. Any Project-related ungulate or large carnivore mortality will be investigated to determine if further action is needed (other species will be dealt with on a species-by-species basis).

7.2 Wildlife Indicator Monitoring

7.2.1 Caribou

Several specific monitoring programs targeting Caribou will also be implemented and are detailed in the WPP (**Appendix 31-F**). Caribou-specific monitoring will include both the Fortymile Caribou herd, and the Klaza Caribou herd and will include:

- Late winter habitat use and Caribou distribution (aerial survey program) — monitoring of both indirect habitat loss and habitat use during the late winter season;
- Annual habitat use within 10 km of the Mine Site (pellet removal plot program) — looking at indirect habitat loss;
- Fortymile Caribou distribution and migration (analysis of satellite collar data) — collar data from the government-sponsored Caribou satellite collaring program will be analyzed to inform distribution patterns and observe broader variation that may not be directly related to Project effect(s), particularly in regards to migration movements on the Fortymile Caribou.

7.2.2 Moose

Direct habitat loss and Project-related mortality on Moose will be tracked along with other Wildlife species as part of the general Wildlife monitoring programs (i.e., Project Footprint monitoring and Project-related Mortality monitoring). Outside of general Project monitoring, specific monitoring for Moose will include:

- Late winter habitat use and distribution (aerial survey program) — monitoring of both indirect habitat loss and habitat use during the late winter season.

7.2.3 Thinhorn Sheep

The Project does not directly affect Thinhorn Sheep habitat; however, the NAR located along the Ballarat Creek valley in this area and may interact with Sheep moving along the Yukon River cliffs. Monitoring efforts will provide additional baseline information on Sheep presence and movement and will involve two monitoring objectives:

- Monitor Sheep habitat use and distribution along the Yukon River in the vicinity of the Project (i.e., the Ballarat occurrence area)
- Monitor Sheep movement along travel corridors through the Ballarat Creek valley.

7.2.4 Wolf Road Use

Wolf and other predator use of the access road is intended as a research-level question to address the possibility that road maintenance activities are facilitating the use of the general area by predators. To address this question, a monitoring program looking at wolf presence along the NAR was initiated during baseline studies and will continue through construction and the initial years of operation. The monitoring objective for this program is to:

- Monitor Wolf use of roads along the NAR and determine whether Wolf presence increases as a result of Project road maintenance.

Monitoring programs will be implemented once mitigation measures are in place and the monitoring program design, including monitoring methods, identification of thresholds, monitoring locations and frequency of monitoring will be developed for each monitoring program. An adaptive management approach will require that the results of monitoring programs, including incident investigations, shared traditional or local knowledge, new or improved scientific methods, regulatory changes, or other Project-related changes will be continuously reviewed so that mitigation measures and monitoring programs can be adapted.

7.3 COLLABORATION ON REGIONAL AND INDUSTRY RESEARCH

The Proponent takes its environmental responsibilities very seriously and is committed to making a positive difference in the areas in which Project teams work. While the effects of the Project on Wildlife and Wildlife habitats are expected to be managed through the mitigation actions and monitoring programs previously identified, the Proponent recognizes that there may be knowledge gaps regarding Wildlife and Wildlife habitat, and/or the effects of industrial disturbance on Wildlife that are not addressed by the identified Project-specific mitigation and monitoring programs. The Proponent is committed to developing strong partnerships to increase regional knowledge and/or industry management to improve understanding and future decision making.

During the baseline data collection stage, the Project team collaborated with local First Nations, government biologists, and academia in several initiatives, including, but not limited to:

- Collaboration with Environment Yukon on habitat modelling for the Fortymile Caribou herd (2015/2016)
- Partnering with Environment Yukon on the early winter Moose survey in the Dawson Goldfields region in November 2015
- Partnering with Yukon College and Tr'ondëk Hwëch'in to develop and implement educational and training initiatives in conjunction with research opportunities at the Coffee Property (e.g. Northern Terrestrial Restoration course and reclamation research in 2015).

The Proponent will continue this collaborative approach to supporting research into regional or industry-related Wildlife management issues. This ongoing support may be conducted in partnership with First Nations, government biologists, and/or academia. Support of specific program or research opportunities will be determined on a case-by-case basis.

7.4 ADAPTIVE MANAGEMENT

The results of the effects monitoring programs will be used to adaptively manage for any previously unanticipated adverse environmental effects of the Project, and/or to modify mitigation measures as needed. Adaptive management is a planned, systematic process for continuously improving environmental management practices by learning about their outcomes. Situations that may require adaptive management to address unanticipated effects on Wildlife and Wildlife Habitat include:

- Variance from predicted numerical values or exceedance of identified thresholds
- Unexpected events (e.g., mortality within the footprint of the Project)

The predetermined thresholds for potential effects of the Project on Wildlife and Wildlife Habitat may include adverse effects to Wildlife as indicated by a distinct distribution response, or attraction to the site. Any unanticipated effects that are detected through monitoring or through other means, such as an accident, will be addressed with adaptive management measures including:

- If there repeated occurrences of Wildlife encounters beyond existing conditions, an investigation will be undertaken to identify issues and recommend improved mitigation measures
- If a site specific feature, such as a den site or mineral lick is found during Construction or Operations, if possible, changes will be made to reduce the possibility of disturbance to those sites
- If an accident or malfunction occurs during the Construction or Operations phases that results in direct or indirect damage to Wildlife habitat within the Project area, a specific Wildlife monitoring plan, and associated mitigations, will be developed as necessary.

Monitoring plans and mitigation measures will be updated and revised if needed, following results of the Project effects monitoring and will incorporate best management practices that may become available during the life of the Project.

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