16. WILDLIFE AND WILDLIFE HABITAT EFFECTS ASSESSMENT

16.1 INTRODUCTION

This chapter presents the baseline wildlife conditions, effects scoping process, and assessment of potential effects on wildlife as a result of the proposed Harper Creek Project (the Project). It is based on baseline data collected for the Project presented in Appendix 15-A, Terrestrial Wildlife and Vegetation Baseline Report. Several wildlife species were selected as representative wildlife valued components (VCs) for the assessment (Section 16.3). Wildlife species were considered in the effects assessment based on the following:

- an interaction with Project components and activities resulting in the loss or alteration of feeding, breeding, or winter habitat;
- Aboriginal concerns of effects of the Project on biodiversity, loss of habitat, changes in animal populations, and their distribution;
- public and stakeholder concerns of effects of the Project on biodiversity, loss of habitat, and changes in animal populations and their distribution; and
- federal and provincial regulations on wildlife, biodiversity, and conservation.

This chapter follows the effects assessment methodology described in Chapter 8 of this Application for an Environmental Assessment Certificate / Environmental Impact Statement (Application/EIS).

16.2 REGULATORY AND POLICY FRAMEWORK

This section provides an overview of the relevant regulatory framework and regulatory requirements for potential Project-related effects to wildlife. Specific federal and provincial legislation that are relevant to wildlife are detailed below in Table 16.2-1, including the *Species at Risk Act* (SARA; 2002b), *Migratory Bird Convention Act* (MBCA; 1994), the *Canada Wildlife Act* (1985) and British Columbia (BC) *Wildlife Act* (1996b), BC *Environmental Management Act* (2003), *Forest and Range Practices Act* (FRPA; 2002a), and the *Mines Act* (1996a).

In addition to the legislation and policies described above, provincial management strategies and best management practices have been developed that pertain to species at risk, sensitive wildlife, and protection of wildlife habitat. These are briefly described below.

16.2.1 Provincial Red and Blue Lists

Species/ecological communities at risk in BC are placed on provincial lists according to their degree of endangerment. The Red List includes "ecological communities, and indigenous species and subspecies that are extirpated, endangered or threatened in British Columbia" (Province of British Columbia 2011). The Blue List includes "ecological communities, and indigenous species and subspecies of special concern (formerly vulnerable) in British Columbia" (Province of British Columbia 2011). Taxa that are not considered at risk are placed on the Yellow List. Species may be

transferred from one list to another list either because of an actual change in their ecological circumstance (change in risk), or because new data becomes available on their range, taxonomy, population trend, or numbers to justify a change in status. The latter situation is especially relevant for poorly understood taxa for which even basic life history information may be sparse.

Table 16.2-1. Legislation and Policies Relevant to Wildlife and Wildlife Habitat

Legislation, Strategy, or Policy Name	Level of Government	Description
Species At Risk Act (2002b)	Federal	Prohibits the killing, harming, harassing, capturing, taking, possessing, collecting, buying, selling, or trading of individuals (or its parts or derivatives) of endangered, threatened and extirpated species listed in Schedule 1 of the Act. It also prohibits damage or destruction of the residence of one or more individuals of a listed endangered or threatened species, or a listed species if a recovery strategy has recommended its reintroduction into the wild into Canada.
MBCA (1994)	Federal	Prohibits the unauthorized possession, purchasing, selling, or exchanging of migratory birds and their nests, and prohibits the disturbance, destruction, or taking of any nest, egg, or nest shelter of a migratory birds. It also prohibits the unauthorized introduction of harmful substances into areas frequented by migratory birds.
BC *Wildlife Act* (1996b)	Provincial	Controls the hunting, trapping, possession, purchase, and sale of wildlife. It also allows for the creation of special areas for wildlife management and preservation, within which special prohibitions apply. Prohibits the possession, molestation, injury or destruction of a bird or its egg, any occupied bird nest, and the nest (whether occupied or not) of an eagle, peregrine falcon, gyrfalcon, heron, or burrowing owl.
FRPA (2002a)	Provincial	Regulates the activities of forest and range licensees in BC, including requirements for planning, road building, timber harvest, reforestation, and grazing. It also provides for the management of wildlife alongside forest and range activities. Management includes the designation of Ungulate Winter Ranges (UWRs), for important ungulate habitat, and Wildlife Habitat Areas (WHAs) for Identified Wildlife.
BC *Mines Act* (1996a)	Provincial	Applies to all mines during exploration, development, construction, production, closure, reclamation and abandonment. The Act allows for inspections to determine if any provisions of the Act, the code, the regulations or a permit have been contravened and if any detrimental impacts to the environment have occurred.
BC *Environmental Management Act* (2003)	Provincial	Provides an authorization framework and enforcement options by using environmental management tools to protect human health and the quality of water, land, and air in BC.

(continued)

Table 16.2-1. Legislation and Policies Relevant to Wildlife and Wildlife Habitat (completed)

Legislation, Strategy, or Policy Name	Level of Government	Description
Canadian Biodiversity Strategy (1995)	Federal	The three objectives of the Biodiversity Convention are the conservation of biodiversity, the sustainable use of biological resources, and the fair and equitable sharing of benefits resulting from the use of genetic resources.
Kamloops Land and Resource Management Plan (LRMP; Kamloops Interagency Management Committee 1995)	Provincial	A sub-regional land use plan covering 2.2 million hectares (ha) of south-central BC. The three main sections of this plan include Resource Management Zones, Implementation, and Monitoring and Amendment.

16.2.2 Identified Wildlife and Ungulate Winter Range

The FRPA (2002a) regulates the activities of forest and range licensees in BC, including requirements for planning, road building, timber harvest, reforestation, and grazing. It also provides for the management of wildlife alongside forest and range activities. Management includes the designation of UWRs for important ungulate habitat, and WHAs for Identified Wildlife. Identified Wildlife species, as designated under the FRPA, are species that are endangered or vulnerable in BC and may be affected by forest or range management on Crown land. WHAs can be designated for Identified Wildlife and managed for particular species or plant communities and generally contain important habitat elements.

Within UWRs and WHAs, General Wildlife Measures (GWMs) are employed to protect important habitat or features. Sometimes they allow for restricted forest or range activities within the UWR or WHA (e.g., restriction of activities during sensitive periods, such as the breeding season) while other times they prohibit it completely.

The draft order for the Kamloops Timber Supply Area UWR (BC MOE 2009) states that:

> *the general wildlife measures outlined in schedule 1 do not apply for the purposes of exploration, development and production activities when these activities have been authorized for the purpose of subsurface resource exploration, development or production by the Mineral Tenure Act, the Coal Act, the Mines Act, the Petroleum and Natural Gas Act, the Pipeline Act or the Geothermal Resources Act.*

16.2.3 Best Management Practices

Provincial best management practices that are relevant to wildlife and wildlife habitat include *Develop with Care* (BC MOE 2012b), *Guidelines for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia* (BC MFLNRO 2014), *Standards and Best Practices for Instream Works* (BC MWLAP 2004c), *Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia* (BC MFLNRO 2013), *and Guidelines for Minimizing Impacts from Mining Exploration on Wildlife and Habitat* (BC MOE 2008a, 2008b).

16.3 SCOPING THE EFFECTS ASSESSMENT

16.3.1 Valued Components

The British Columbia Environmental Assessment Office (BC EAO) defines VCs as components "that are considered important by the proponent, public, First Nations, scientists, and government agencies involved in the assessment process" (BC EAO 2013). To be included in the Application/EIS, there must be a perceived likelihood that the VC will be affected by the proposed Project. VCs proposed for assessment were identified in the Application Information Requirements (AIR; BC EAO 2011) and in the Canadian Environmental Assessment Agency (CEA Agency 2011) Background Information document.

16.3.1.1 Consultation Feedback on Proposed Valued Components

A preliminary list of proposed VCs was drafted early in project planning based on the expected physical works and activities of the project; type of project being proposed; local area and regions where the proposed project would be located; and consultation with federal, provincial, and local government agencies. A summary of how scoping feedback was incorporated into the selection of VCs is presented below in Table 16.3-1. This table summarizes the selection process using scoping feedback for VCs that were included in the Application Information Requirements (AIR). Table 16.3-4 provides rationale for exclusion of other wildlife species identified during consultation.

Table 16.3-1. Consultation Feedback on Proposed Valued Components

Subject Area	Feedback by*			Issues Raised	Proponent Response
	AG	G	P/S		
Butterflies		✓		Effects to Species at Risk	Considered as a potential VC during baseline studies (terrestrial invertebrates) but excluded from the effects assessment (Table 16.3-4).
Damselflies and dragonflies		✓		Effects to Species at Risk	Considered as a potential VC during baseline studies (terrestrial invertebrates) but excluded from the effects assessment (Table 16.3-4).
Western toad *Anaxyrus boreas*		✓		Effects on wildlife and wildlife habitat, and effects to Species at Risk	Considered as a potential VC and effects are assessed in Section 16.6.1.
Barn Swallow *Hirundo rustica*		✓		Effects to migratory birds and to Species at Risk	Considered as a potential VC and effects are assessed in Section 16.6.2
Common Nighthawk *Chordeiles minor*		✓		Effects to migratory birds and to Species at Risk	Considered as a potential VC and effects are assessed in Section 16.6.3
Great Blue Heron *Ardea herodias*	✓	✓		Effects to migratory birds and to Species at Risk, identified on ALIB animal list	Considered as a potential VC during baseline studies (Appendix 15-A) but excluded from the effects assessment (Table 16.3-4).

(continued)

Table 16.3-1. Consultation Feedback on Proposed Valued Components (continued)

Subject Area	Feedback by* AG	G	P/S	Issues Raised	Proponent Response
Harlequin Duck *Histrionicus histrionicus*	✓		✓	Effects to migratory birds and to Species at Risk, identified on ALIB animal list (ducks)	Considered as a potential VC and effects are assessed in Section 16.6.4
Olive-sided Flycatcher *Contopus cooperi*		✓		Effects to migratory birds and to Species at Risk	Considered as a potential VC and effects are assessed in Section 16.6.5
Bald Eagle *Haliaeetus leucocephalus*	✓		✓	Effects to wildlife and wildlife habitat, identified on ALIB animal list	Considered as a potential VC and effects are assessed in Section 16.6.6
Northern Goshawk *Accipiter gentilis*			✓	Effects to wildlife and wildlife habitat	Considered as a potential VC and effects are assessed in Section 16.6.7
Western Screech-owl *Megascops kennicottii*		✓		Effects to Species at Risk	Considered as a potential VC during baseline studies (Appendix 15-A) but excluded from the effects assessment (Table 16.3-4)
Bats (Fringed myotis *Myotis thysanodes,* Little brown myotis *Myotis lucifugus, and* Northern myotis *Myotis septentrionals)*		✓		Effects to Species at Risk	Considered as a potential VC and effects are assessed in Section 16.6.8. Some bat species were excluded from the effects assessment (Table 16.3-4)
Fisher *Pekania pennanti*	✓	✓		Identified on ALIB animal list and MNBC; effects to Species at Risk	Considered as a potential VC and effects are assessed in Section 16.6.9 (Furbearers)
Wolverine *Gulo gulo*	✓	✓		Identified on ALIB animal list; effects to Species at Risk	Considered as a potential VC and effects are assessed in Section 16.6.9 (Furbearers)
Grizzly bear *Ursus arctos*	✓	✓		Identified on ALIB animal list; effects to Species at Risk; effects on grizzly bear	Considered as a potential VC and effects are assessed in Section 16.6.10
Moose *Alces americanus*	✓		✓	Identified on ALIB animal list; moose use of the Project area; effects on wildlife and wildlife habitat	Considered as a potential VC and effects are assessed in Section 16.6.11
Mountain caribou *Rangifer tarandus*	✓	✓		Identified on ALIB animal list and by SFN; effects to Species at Risk; effects on caribou	Considered as a potential VC and effects are assessed in Section 16.6.12

(continued)

Table 16.3-1. Consultation Feedback on Proposed Valued Components (completed)

Subject Area	Feedback by*			Issues Raised	Proponent Response
	AG	G	P/S		
Mountain goat *Oreamnos americana*	✓		✓	Identified on ALIB animal list; effects on goats due to helicopters	Considered as a potential VC during baseline studies (Appendix 15-A) but excluded from the effects assessment (Table 16.3-4)
Mule deer *Odocoileus hemionus*	✓		✓	Identified on ALIB animal list	Considered as a potential VC and effects are assessed in Section 16.6.13

**AG = Aboriginal Group (including ALIB animal list); G = Government; P/S = Public/Stakeholder.*

16.3.1.2 Selecting Valued Components

Selection of VCs for assessment is undertaken to focus the Application/EIS on the issues of highest concern and on the effects that may be linked to the Project. To be considered a VC for assessment purposes, a component must meet the following criteria.

1. Potential interaction due to overlap (spatial and temporal) between the Project and proposed VCs. The identification of potential interactions is based on issues or concerns raised during the EA pre-application phase and through consultation activities (Chapter 3), scientific knowledge, past experience on other mining projects (particularly in the interior of BC) and professional judgment;
2. Legislative or regulatory requirement, or government management priority, and the input of regulators, First Nations, and other stakeholder groups; and

The availability of data and analytical tools to measure effects on the VC.

To identify wildlife VCs for the Project, the BC Conservation Data Centre (BC CDC) was queried to identify all wildlife within the Headwaters Forest District or Kamloops Forest District that were Red- or Blue-listed, SARA-listed, Committee on the Status of Endangered Wildlife in Canada (COSEWIC)-listed, or Identified Wildlife, and that may potentially occur within the study area (BC CDC 2014). The Headwaters Forest District and Kamloops Forest District are provincial management units for the British Columbia Ministry of Forests, Lands and Natural Resource Operations (BC MFLNRO) that overlap the local study area (LSA).

Determination of potential occurrence was supplemented by reviewing actual known location records of rare species (BC CDC 2014) and through observations made during Project field studies. BC CDC observation records have been summarized within individual VC background summaries (see Appendix 15-A, Terrestrial Wildlife and Vegetation Baseline Report). Field study observations are summarized in Appendix 15-A. No additional VCs were identified through this process.

Species of regional concern were identified as VCs during the development of the AIR, through discussions with BC MFLNRO, and through review of the Conservation Framework (BC MOE 2012a). Several species of concern to First Nations were also identified as VCs following EA Working

Group meetings, during discussions between the proponent and First Nations, and during discussions with First Nations personnel involved in terrestrial wildlife and vegetation fieldwork.

The potential interaction between the selected VCs and the Project components and activities was undertaken using the list of Project components and activities included in Appendix 8-A, Interaction of Project Components and Activities with Proposed Valued Components. A summary of the interaction between the VCs and each component and activity category is provided in Table 16.3-2.

Table 16.3-2. Interaction of Project Components and Activities with Valued Components

Category	Terrestrial Invertebrates	Amphibians	Migratory Birds	Raptors	Bats	Furbearers	Large Mammals	Ungulates
Construction								
Concrete production			x	x	x	x	x	x
Dangerous goods and hazardous materials								
Environmental management and monitoring		x	x	x	x	x	x	x
Equipment		x	x	x	x	x	x	x
Explosives			x	x	x	x	x	x
Fuel supply, storage, and distribution								
Open pit		x	x	x	x	x	x	x
Potable water supply								
Power supply		x	x	x	x	x	x	x
Processing		x	x	x	x	x	x	x
Procurement and labour								
Project Site development		x	x	x	x	x	x	x
Rail load-out facility			x		x			x
Roads		x	x	x		x	x	x
Stockpiles		x	x	x	x	x	x	x
Tailings management		x	x	x	x	x	x	x
Temporary construction camp		x	x	x	x	x	x	x
Traffic		x	x	x		x	x	x
Waste disposal		x		x		x	x	x
Water management		x	x	x	x	x	x	x
Operations 1								
Concentrate transport		x				x	x	x

(continued)

Table 16.3-2. Interaction of Project Components and Activities with Valued Components (continued)

Category	Terrestrial Invertebrates	Amphibians	Migratory Birds	Raptors	Bats	Furbearers	Large Mammals	Ungulates
Operations 1 (*cont'd*)								
Dangerous goods and hazardous materials								
Environmental management and monitoring		x	x	x		x	x	x
Equipment		x	x	x		x	x	x
Fuel supply, storage, and distribution							x	
Mining		x	x	x		x	x	x
Ore processing		x	x	x		x	x	x
Potable water supply								
Power supply								
Processing		x	x	x	x	x	x	x
Procurement and labour								
Rail load-out facility		x	x					
Reclamation and decommissioning		x	x	x		x	x	x
Stockpiles		x	x	x	x	x	x	x
Tailings management		x	x		x	x	x	x
Traffic		x	x	x		x	x	x
Waste disposal		x		x		x	x	
Water management								
Operations 2								
Processing			x					x
Reclamation and decommissioning								
Tailings management		x	x	x	x	x	x	x
Water management		x			x			
Closure								
Environmental management and monitoring		x	x	x		x	x	x
Open pit			x		x			
Procurement and labour								
Reclamation and decommissioning		x	x	x		x	x	x
Stockpiles								

(continued)

Table 16.3-2. Interaction of Project Components and Activities with Valued Components (completed)

Category	Terrestrial Invertebrates	Amphibians	Migratory Birds	Raptors	Bats	Furbearers	Large Mammals	Ungulates
Closure (*cont'd*)								
Tailings management			x		x			
Waste disposal								
Post-Closure								
Environmental management and monitoring		x	x	x		x	x	x
Open pit			x		x			
Procurement and labour								
Stockpiles								
Tailings management		x	x		x			

Note: a column is marked with an X when it has been determined that the Project component or activity could potentially interact with the VC.

16.3.1.3 Summary of Valued Components Included or Excluded in the Application/EIS

The wildlife VCs selected for the Project are presented in Table 16.3-3, along with a rationale for their inclusion in the assessment. Potential VCs that were considered but were not included in the assessment are presented in Table 16.3-4, with a rationale for their exclusion.

Table 16.3-3. Wildlife Valued Components Included in the Application/EIS

Wildlife Group	Valued Component	Rationale for Inclusion
Amphibians	Western Toad	Western toads are provincially Blue-listed and are a species of Special Concern under Schedule 1 of SARA (2002b). This species has a priority rating of 2 for goal 2 in BC's Conservation Framework, meaning that the province is interested in preventive conservation to keep this species from becoming at risk. During baseline surveys, breeding ponds were confirmed in the LSA near the TMF and pit. Western toads are included as a VC due to their known presence and confirmed breeding ponds in the LSA and because they are federally listed under Schedule 1 of SARA.

(continued)

Table 16.3-3. Wildlife Valued Components Included in the Application/EIS (continued)

Wildlife Group	Valued Component	Rationale for Inclusion
Migratory Birds and Raptors	Barn Swallow	Individual birds, eggs, and active nests are protected under the *Migratory Birds Convention Act*. Barn Swallows are provincially Blue-listed and are designated as Threatened by COSEWIC (BC CDC 2014). Barn Swallows were observed at low elevations in the LSA and were selected as a representative migratory bird due to their provincial and federal conservation status and their reliance on man-made structures for nesting.
	Common Nighthawk	Individual birds, eggs and active nests are protected under the *Migratory Birds Convention Act*. Common Nighthawks are provincially Yellow-listed, are listed on Schedule 1 of SARA (2002b), and designated as Threatened by COSEWIC. Common Nighthawks were observed in the North Thompson River Valley during baseline surveys and were selected as a representative migratory bird due to the provincial and federal conservation status and their unique habitat requirements.
	Harlequin Duck	Individual birds, eggs, and active nests are protected under the *Migratory Birds Convention Act*. Harlequin Ducks are provincially Yellow-listed, and were identified as a species of First Nations and regional concern during Project consultations, due to its potential sensitivity to impacts on breeding streams and rivers. Suitable habitat was identified along Harper Creek and its tributaries, but no Harlequin Ducks were detected during baseline surveys. Although no Harlequin Ducks were observed, they were included as a VC as a representative species occupying riverine habitat.
	Olive-sided Flycatcher	Individual birds, eggs, and active nests are protected under the *Migratory Birds Convention Act*. Olive-sided Flycatchers are provincially Blue-listed, are listed on Schedule 1 of SARA, and are designated as Threatened by COSEWIC (BC CDC 2014). Olive-sided Flycatchers were observed throughout the LSA during baseline surveys and suitable habitat was modelled throughout the LSA. Olive-sided Flycatchers were selected as a representative migratory bird due to their provincial and federal conservation status and their habitat requirements (including conifer forests and edge habitat).
	Bald Eagle	Active raptor nests are protected under the BC *Wildlife Act*, and Bald Eagle nests are protected year-round (i.e., active or inactive; Pahlke, McPherson, and Marshall 1996). Bald Eagles are identified by First Nations as culturally important. The species is provincially Yellow-listed, but is also considered a species of regional concern (BC CDC 2014); Two active Bald Eagle nests were observed in the North Thompson River Valley during baseline surveys and suitable habitat was modelled in the North Thompson River Valley.

(continued)

Table 16.3-3. Wildlife Valued Components Included in the Application/EIS (continued)

Wildlife Group	Valued Component	Rationale for Inclusion
Migratory Birds and Raptors (*cont'd*)	Northern Goshawk	Active raptor nests are protected under the BC *Wildlife Act* (Pahlke, McPherson, and Marshall 1996). Northern Goshawks are identified by First Nations as culturally important. During baseline surveys, two adult Northern Goshawks were incidentally observed along the upper Jones Creek FSR, and along Resource Road 5 on the plateau. Based on nesting habitat suitability mapping, Northern Goshawks are expected to reside in greater densities at the lower elevations of the IDF and ICH within the LSA. The Northern Goshawk was included as a VC because it is a species of regional concern in BC, is culturally important to First Nations and is sensitive to habitat alteration.
Bats	Bat species at risk (fringed myotis, little brown myotis, northern myotis)	Three bat species were considered in the Application/EIS based on baseline survey results: little brown myotis, fringed myotis, and northern myotis. The little brown myotis is listed as Endangered by COSEWIC (COSEWIC 2012b) over concerns with white-nose syndrome. Little brown myotis were detected throughout the LSA during baseline surveys. Fringed myotis is provincially Blue-listed, classified as Identified Wildlife, listed on Schedule 3 of SARA (2002b), and is listed by COSEWIC as data deficient (BC CDC 2014). Fringed myotis were detected at low elevation in the LSA during baseline surveys. Northern myotis is provincially Blue-listed and was emergency-listed by COSEWIC on February 3, 2012 as Endangered due to the precipitous population declines in eastern Canada caused by white-nose syndrome (BC CDC 2014; COSEWIC 2014). The status of the northern myotis was re-examined and confirmed by COSEWIC in November 2013 (COSEWIC 2014). Northern myotis were detected throughout the LSA during baseline surveys. Because of the lack of regional knowledge about this wildlife group and their ability to habituate to anthropogenic structures, bats are included as a VC.
Furbearers	Wolverine	The wolverine is provincially Blue-listed, is an Identified Wildlife Species under the FRPA, and has been designated as a species of special concern by COSEWIC (Reynolds 2002; BC CDC 2014). Furbearers are important to First Nations and local harvesting. Wolverine tracks were observed during baseline surveys in the LSA.
	Fisher	Fisher are Blue-listed in BC and is an Identified Wildlife species under the FRPA (BC CDC 2014). Furbearers are important to First Nations and local harvesting. Fisher tracks were observed during baseline surveys in the LSA.

(continued)

Table 16.3-3. Wildlife Valued Components Included in the Application/EIS (completed)

Wildlife Group	Valued Component	Rationale for Inclusion
Bears	Grizzly Bear	Grizzly bear are provincially Blue-listed, federally listed as a species of Special Concern, is an Identified Wildlife species under FRPA, and a species of cultural importance for First Nations. Foraging habitat for grizzly bears exists in the LSA and two sets of grizzly bear tracks were observed during baseline surveys in the LSA. It is expected that grizzly bears rarely use the LSA due to existing high road densities, but are included as a VC due to their sensitivity to habitat alteration/disturbance and because of their conservation status and cultural importance for First Nations.
Ungulates	Moose	Moose are a species of regional and First Nations concern. The Kamloops LRMP identifies and manages Critical Moose Winter Range (CMWR) through access management, harvest management, and forage management (Kamloops Interagency Management Committee 1995). Moose tracks were observed during baseline snow-tracking studies in 2008 and 2011. Suitable winter and growing season habitat occurs within the LSA (1,012.5 ha of CMWR and approximately 8,000 ha of growing season habitat).
	Mountain Caribou	The southern mountain population (population 1) may occur in the regional study area (RSA); this population is provincially Red-listed, listed on Schedule 1 of SARA, and designated as Threatened by COSEWIC (BC CDC 2014). There are two southern mountain caribou planning units that are adjacent, but not overlapping the RSA: the Revelstoke – Shuswap unit to the south (Planning Unit 3A; 205 individuals) and the Wells Gray – Thompson to the north (Planning Unit 4A; 274 individuals; Mountain Caribou Science Team 2005; BC Ministry of Agriculture and Lands 2007). Mountain caribou was identified as a species of interest by the provincial government, federal government, and First Nations. Two sets of tracks that may have been caribou tracks were observed during baseline studies, and potentially suitable habitat occurs within the LSA. Although there is no current evidence of use in the LSA and the caribou planning units do not overlap with the LSA or RSA, caribou were considered a VC because of their conservation status and interest to local residents and First Nations.
	Mule Deer	The Kamloops LRMP identifies and manages Critical Deer Winter Range (CDWR). Critical habitats are managed in the LRMP using access management, harvest management, and forage management (Kamloops Interagency Management Committee 1995). Mule deer are expected to occur in the LSA (although only one set of tracks was observed) and 355.6 ha of CDWR overlaps with the LSA. During Project consultations, mule deer was identified as a VC due to First Nations and regional concern.

Based on the baseline data collected and present understanding of the Project, Table 16.3-4 provides rationale for VCs excluded from the assessment, as they will have unmeasurable or no interactions with the Project and thus will not be assessed further in the effects assessment.

Table 16.3-4. Wildlife Excluded from the Application/EIS

Wildlife Group	Valued Component	Rationale for Exclusion
Invertebrates	Butterflies	• No species of concern were identified within the LSA during surveys. The majority of the Project occurs at high elevations, where butterfly abundance and diversity are typically lower.
	Damselflies and Dragonflies	• No species of concern were identified within the LSA during surveys. The majority of the Project occurs at high elevations, where dragonfly and damselfly abundance and diversity are typically lower.
Ungulates	Mountain Goat	• The nearest goat winter range is approximately 3 kilometres (km) away from Project footprints, and no escape terrain for goats exists within the LSA. • The proponent has stated that helicopters will not be required as part of the Project due to the availability of alternative ground access. • No suitable habitat was observed in the LSA and no mountain goats were observed during baseline surveys.
Carnivores, rodents, rabbits, and hares	Black bear, coyote, fox, lynx wolf, marten, mink, muskrat, beaver, hare, rabbit, squirrel, marmots	• These carnivore species were identified as culturally important for First Nations (including the ALIB animal list). • These species were excluded for various reasons, such as because their populations are considered stable and not at risk, have low population density, and are able to adapt to and tolerate human disturbance well. Moreover, their populations are largely determined by prey (e.g., lynx). • The potential for black bear-human interactions is considered in the grizzly bear assessment (Section 16.6.10.4) and management (16.5.2.3). • Rodent species (e.g., beaver, rabbit, snowshoe hare, red squirrel, flying squirrel, muskrat) were identified as culturally important for First Nations. These species were excluded because all of the aforementioned populations are considered stable and not at risk. Further, important habitats for some of these species, specifically beaver and muskrat dams and lodges, are protected under a separate permitting process under the *Wildlife Act* (Pahlke, McPherson, and Marshall 1996). • Suitable habitat for marmot is does not occur in the LSA.
Bats	Bat species at risk	• Townsend's big-eared bat were excluded as a VC because during two years of acoustic surveys and one year of capture surveys this species was not detected and thus is not likely to be affected by the Project. • Western small-footed myotis were excluded as a VC because this species was not detected during two years of acoustic surveys and one year of capture surveys, and thus is not likely to be affected by the Project.
Birds	Great Blue Heron	• No herons or heron nests were observed in the LSA, and no suitable heron nesting habitat will be affected by the Project. No measurable effect is expected to great blue heron.
	Western Screech Owl	• The Project is north of the known range of this species (COSEWIC 2002b; BC CDC 2012). Due to uncertainty on their northern distribution extent, surveys were conducted in the LSA but no Western Screech Owls were located. This species is not likely present within the LSA and was excluded as a VC.

(continued)

Table 16.3-4. Wildlife Excluded from the Application/EIS (completed)

Wildlife Group	Valued Component	Rationale for Exclusion
Birds (*cont'd*)	Other Waterfowl	• Waterfowl were considered as a potential VC but were not included in the final list. There is little waterfowl habitat in the vicinity of the mine footprint and few waterfowl were observed at the high elevation of the footprints. The waterbodies and wetlands in the LSA are of low suitability due to the short growing season and relatively low productivity of the ESSF biogeoclimatic zone. The tailings management facility (TMF) is not expected to be attractive to waterfowl due to the climate limitations and the lack of waterfowl forage and cover plants around that facility.

16.3.2 Defining Assessment Boundaries

Assessment boundaries define the maximum limit within which the effects assessment and supporting studies (e.g., predictive models) are conducted. Boundaries encompass where and when the Project is expected to interact with the VCs; any political, social, and economic constraints; and limitations in predicting or measuring changes. Boundaries relevant to wildlife are described below.

16.3.2.1 Temporal Boundaries

Temporal boundaries, provided in Table 16.3-5, are the time periods considered in the assessment for various Project phases and activities. Temporal boundaries reflect those periods during which planned Project activities are reasonably expected to potentially affect a VC. Potential effects will be considered for each phase of the Project as described in Table 16.3-5.

Table 16.3-5. Temporal Boundaries used in the Assessment for Wildlife

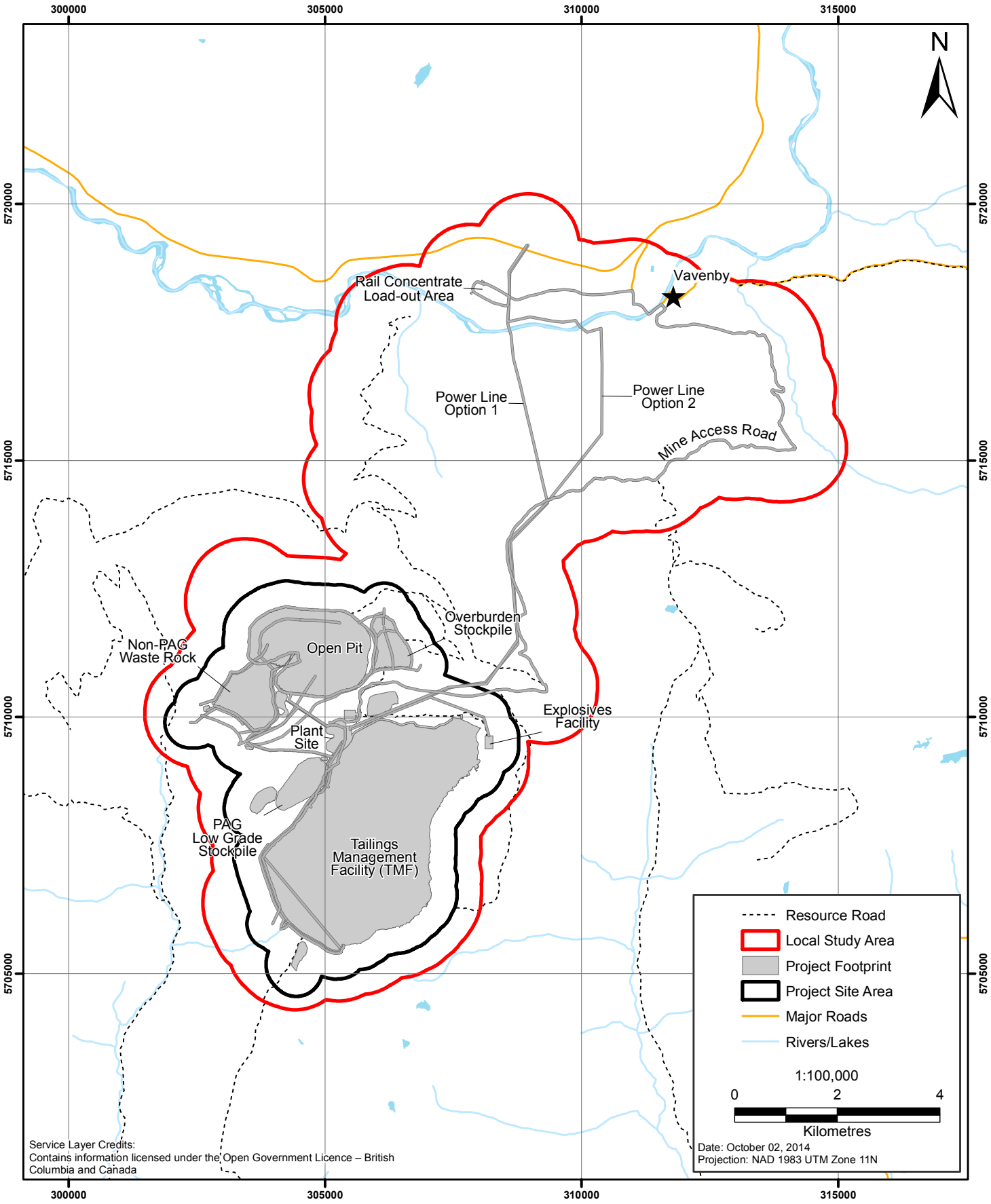
Phase	Project Year	Length of Phase	Description of Activities
Construction	-2 and -1	2 years	Pre-construction and construction activities
Operations 1	1 - 23	23 years	Active mining in the open pit from Year 1 through to Year 23.
Operations 2	24 - 28	5 years	Low-grade ore processing from the end of active mining through to the end of Year 28.
Closure	29 – 35	7 years	Active closure and reclamation activities while the open pit and TMF are filling.
Post-Closure	36 onwards	50 years	Steady-state long-term closure condition following active closure, with ongoing monitoring.

16.3.2.2 Spatial Boundaries

<u>Project Site</u>

The Project Site is defined by a buffer of 500 m around the primary Project components (Figure 16.3-1). Project components include the open pit; the open pit haul road, primary crusher, and ore conveyor; mill plant site with ore processing facilities and intake/outtake pipelines; TMF; overburden, topsoil, potentially acid-generating (PAG) waste rock, and non-PAG waste rock stockpiles; and non-PAG and PAG low-grade ore stockpiles.

Figure 16.3-1
Wildlife Effects Assessment Local Study Area



Local Study Area

An LSA was identified as the primary area for baseline studies of wildlife for the Project—the majority of baseline studies and the Terrestrial Ecosystem Mapping (TEM) were both conducted within this boundary. The LSA encompassed all Project facilities and an area of 1,000 m on all sides of these facilities (Figure 16.3-1), for a total size of 11,084.5 ha. The LSA includes areas beyond the Project footprint where both direct and indirect Project-specific effects are most likely to occur for wildlife. The LSA takes into consideration available information and professional opinion on zones of influence (i.e., area of reduced use or avoidance), and prescribed or recommended setbacks (Environment Canada 2009; Government of Alberta 2011; BC MOE 2012b).

Regional Study Area

A RSA 150,010 ha in size was established as a secondary area for baseline data collection in order to provide additional context on wider-ranging wildlife species (e.g., grizzly bear). The RSA was also used as the assessment area for cumulative effects within the EIS.

The RSA consisted of the Vavenby and Barriere Landscape Units (LUs), which encompasses the Project, the LSA, and a broader surrounding area where there is potential for interaction of the proposed Project with past, present, and future activities that might result in cumulative adverse effects on wildlife (Figure 16.3-2). LUs are spatially identified areas of land used for long-term planning or resource management activities. LUs are used for designing strategies and objectives to maintain landscape-level biodiversity and for managing other forest resources such as old-growth forest retention and timber harvesting. Readily identifiable physiographic or geographic features such as a single large watershed or a group of smaller watersheds form the basis of LU delineation, and therefore the RSA.

16.4 BASELINE CONDITIONS

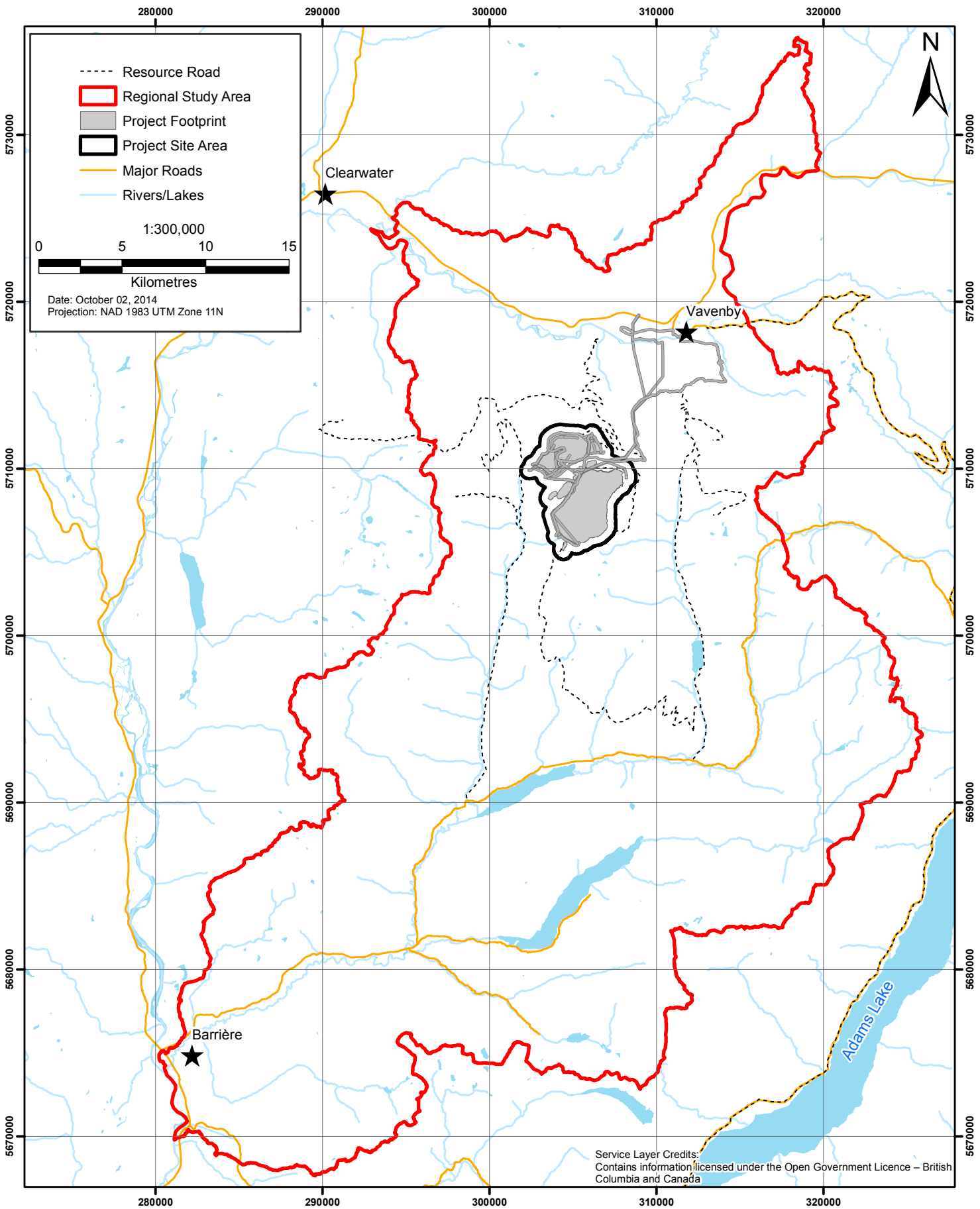
16.4.1 Regional and Historical Setting

The Project's regional wildlife and habitat values are described in the Vegetation and Wildlife Baseline Report included as Appendix 15-A, and are briefly summarized here. The baseline report also includes results from baseline surveys conducted on site, which are summarized in Section 16.4.3.

Vegetation within the LSA varies according to elevation. The LSA is composed of the following biogeoclimatic (BGC) variants: the Thompson Moist Warm Interior Douglas-Fir variant (IDFmw2), the North Thompson Dry Warm Interior Cedar – Hemlock variant (ICHdw3), the Thompson Moist Warm Interior Cedar – Hemlock variant (ICHmw3), the Wells Gray Wet Cool Interior Cedar – Hemlock variant (ICHwk1), the Northern Monashee Wet Cold Engelmann Spruce – Subalpine Fir variant (ESSFwc2), the Wet Cold Engelmann Spruce – Subalpine Fir Woodland subzone (ESSFwcw), and the Wet Cold Engelmann Spruce – Subalpine Fir Parkland subzone (ESSFwcp).

Figure 16.3-2

Wildlife Effects Assessment Regional Study Area



The IDFmw2 occurs from the valley bottoms (375 m) to 1,150 m elevation, and is characterized by forests of Douglas-fir (*Pseudotsuga menziesii*), lodgepole pine (*Pinus contorta*), paper birch (*Betula papyrifera*), and trembling aspen (*Populus tremuloides*). Above the IDF, the three ICH variants are dominated by a mixture of broadleaf and conifer species including western red cedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), lodgepole pine, Douglas-fir, paper birch, trembling aspen, hybrid Engelmann x white spruce (*Picea engelmannii* x *glauca*), subalpine fir (*Abies lasiocarpa*), and western white pine (*Pinus monticola*).

The two forested ESSF variants occur at higher elevations of 1,300 to 2,000 m, and are characterized by a short growing season due to long, cold winters and short, cool summers. Climax stands of Engelmann spruce (*Picea engelmannii)* and subalpine fir dominate the landscape. The parkland ESSFwcp occurs at the highest elevations within the study area. Discontinuous forests of stunted subalpine fir tree islands occur in this variant.

Extensive human developed has occurred in the region relating to harvesting and recreational use. Within the RSA, 56,443 ha (37.6% of the RSA) have been logged since the forest industry began operations in the area, according to a recent Vegetation Resource Inventory (VRI). Approximately half of the logging to date occurred prior to 1960. Consequently, the remaining forest is fragmented, as a result of forestry and increased road density and grazing in the area. Most of the roads are actively used by forestry, recreational users (hunters, hikers, snowmobilers), and travelers (driving between the towns of Vavenby and Barriere).

The Project RSA lies within "Region 3 – Thompson" of the Hunting and Trapping Regulations Synopsis; four Management Unit (MU) boundaries (3-37, 3-38, 3-41, and 3-42) divide up the RSA (BC MFLNRO 2012b). The hunting of ungulates, furbearers, large carnivores, waterfowl, and game birds takes place throughout the Project RSA.

The Dunn Peak Protected Area (southwest of the LSA) is a large wilderness area that is used for backcountry recreation opportunities. The recent addition of a boardwalk and other recent trail work has improved hiking conditions and increased use of the area. Snowshoeing and backcountry and alpine ski touring opportunities also exist on Dunn Peak (BC MOE 2012c). Both sheep and cattle graze within the RSA, with flocks and herds grazing on rangeland and alpine flower meadows from spring to fall.

16.4.2 Baseline Studies

Baseline conditions were characterized using information from existing literature and field studies that were conducted in 2008 and 2011. The scope of the work was to collect baseline data on wildlife presence and distribution. The following section provides a summary of the baseline conditions for wildlife resources. The section is supported by more detailed information presented in Appendix 15-A.

Baseline studies for most VCs included a combination of field surveys and habitat suitability mapping based on the TEM. Suitability mapping requires that habitat associations be developed by linking the physical characteristics (e.g., plant community and topography) of each ecosystem unit within the TEM to important habitat characteristics required by the species being considered for the

particular life requisite to be mapped. These associations form the foundation of the suitability mapping. Suitability mapping was created following provincial standard methodology described in British Columbia Wildlife Habitat Rating Standards (Resources Inventory Committee 1999a).

16.4.2.1 Amphibians (Western Toad)

Western toads (*Anaxyrus boreas*) are a federally listed species of Special Concern, protected under Schedule 1 of SARA, and are Blue-listed in BC. Hence, the wildlife characterization for amphibians focused on western toad. Prior to baseline studies for the Project, provincial government databases (BC Conservation Data Centre, Wildlife Species Inventory database, and EcoCat) were searched for information on western toad occurrence within or near the LSA. Baseline studies consisted of four methods: 1) road encounter surveys; 2) time-constrained pond surveys; 3) larval pond surveys; and 4) wildlife habitat suitability mapping (see Appendix 15-A for detailed information on wildlife baseline studies). The objective of these studies was to confirm presence and distribution of western toad, as well as suitable habitat within the LSA.

Road surveys were conducted along Jones Creek Forest Service Road (FSR) on June 21, June 23, and July 15 to 16, 2008, and along Birch Island Road on June 23, 2011, following methods outlined in *Inventory Methods for Pond-Breeding Amphibians and Painted Turtle* (Resources Inventory Committee 1998c). Timing of surveys was focused on June and July when adults were potentially moving towards and away from breeding habitat. Amphibians that were observed were recorded, including species, age class, and location of detection (UTM NAD 83).

Time-constrained pond surveys were conducted on June 21 to 25, 2008; July 14 to 17, 2008; July 29 to 21, 2011; and August 10, 2011, following standards outlined in *Inventory Methods for Pond-Breeding Amphibians and Painted Turtle* (Resources Inventory Committee 1998c). Areas for pond surveys were identified by stratifying the LSA based on Project footprint locations and areas containing wetlands. All amphibians detected were recorded, including species, development stage, and count.

Larval surveys were conducted in 2008 and followed standards outlined in *Inventory Methods for Pond-Breeding Amphibians and Painted Turtle* (Resources Inventory Committee 1998c). Searches occurred at wetlands that had been identified in the pre-field review for time-constrained pond surveys (see Appendix 15-A; Figure 11). All amphibians observed were recorded including their species, age class, and total length.

Suitable habitat was mapped within the LSA using provincial standard methods for habitat mapping outlined in *British Columbia Wildlife Habitat Ratings Standards* (Resources Inventory Committee 1999a). Western toad reproductive habitat was mapped for this species, because it is typically the most limiting habitat for this species. A species-habitat model was developed to relate western toad habitat requirements to characteristics within the ecosystem mapping, and the model was used to produce a map of habitat suitability. Species-habitat models are provided in Appendix 3 of the wildlife baseline report (Appendix 15-A). Field studies were undertaken to confirm the accuracy of assumptions within the species-habitat model, and to adjust those assumptions where necessary prior to finalization of the habitat suitability map.

16.4.2.2 Barn Swallow

Prior to baseline studies for the Project, provincial government databases (BC CDC, Wildlife Species Inventory database, and EcoCat) and online public databases (BC Breeding Bird Atlas) were searched for information on Barn Swallow occurrence within or near the LSA. Baseline studies for Barn Swallow consisted of habitat suitability mapping and breeding bird surveys (see Appendix 15-A for detailed information on wildlife baseline studies). The objective of these studies was to confirm presence and distribution of Barn Swallows and their suitable habitat within the LSA.

Suitable habitat was mapped using provincial standard methods for habitat mapping outlined in *British Columbia Wildlife Habitat Ratings Standards* (Resources Inventory Committee 1999a). Barn Swallows occur in BC during the breeding season (Campbell et al. 1997). Nesting habitat is considered the most limiting type of habitat, thus it was selected for habitat mapping and analysis for the effects assessment. A species-habitat model was developed to relate Barn Swallow habitat requirements to characteristics within the ecosystem mapping, and the model was used to produce a map of habitat suitability. Field studies were undertaken to confirm the accuracy of assumptions within the species-habitat model, and adjust those assumptions where necessary prior to finalization of the habitat suitability map.

Breeding bird surveys were conducted using provincial standard methods outlined in *Inventory Methods for Forest and Grassland Songbirds* (Resources Inventory Committee 1999b). Initial surveys were conducted in 2008, with additional surveys in 2011 of areas previously not surveyed, as well as to revisit those areas initially surveyed in 2008. Surveys were conducted between late May and mid-July each year, starting at sunrise and continuing no later than four hours after sunrise. Surveys consisted of point count stations at which all birds heard or seen were recorded, including species, number of individuals observed, sex, age class, activity and, wherever possible, the distance and direction from the observer to the bird.

16.4.2.3 Common Nighthawk

Prior to baseline studies for the Project, provincial government databases (BC CDC, Wildlife Species Inventory database, and EcoCat) and online public databases (BC Breeding Bird Atlas) were searched for information on Common Nighthawk occurrence within or near the LSA. Baseline studies for Common Nighthawk consisted of call-playback surveys (see Appendix 15-A for detailed information on wildlife baseline studies). The objective of these studies was to confirm presence and distribution of Common Nighthawk within the LSA.

Call-playback surveys followed methods outlined in *Inventory Methods for Nighthawk and Poorwill* (Resources Inventory Committee 1998b). Survey stations were placed in proximity to open habitats containing large expanses of exposed ground upon which Common Nighthawks could nest. Surveys were conducted from sunset to twilight in late June of 2012. Call-playback units broadcast a recording of a male Common Nighthawk to elicit territorial responses from any males in the area. If a nighthawk was observed, the sex, age class, distance and direction of that individual were recorded.

16.4.2.4 Harlequin Duck

Prior to baseline studies for the Project, provincial government databases (BC CDC, Wildlife Species Inventory database, and EcoCat) and online public databases (BC Breeding Bird Atlas) were searched for information on Harlequin occurrence within or near the LSA. Baseline studies for Harlequin Duck consisted of ground-based surveys following protocols outlined in *Inventory Methods for Riverine Birds: Harlequin Duck, Belted Kingfisher and American Dipper* (Resources Inventory Committee 1998d). The purpose of the study was to assess presence and distribution of Harlequin Ducks and their suitable habitat along Harper Creek.

Methods are summarized from Summit (2009). Prior to field surveys, creeks and rivers within the LSA were assessed for their potential to support Harlequin Ducks. Harper Creek was identified as the only creek with the potential for Harlequin Duck use, and was targeted for the surveys. Surveys occurred in late July, during the period when Harlequin Duck females were expected to be present on the river with juveniles, but prior to fall migration. Surveys involved foot transects within suitable habitat along the shoreline of Harper Creek and tributaries, with surveyors looking for ducks on the river while walking alongside. Suitable habitat was identified by biologists in the field during the survey.

16.4.2.5 Olive-sided Flycatcher

Prior to baseline studies for the Project, provincial government databases (BC CDC, Wildlife Species Inventory database, and EcoCat) and online public databases (BC Breeding Bird Atlas) were searched for information on Olive-sided Flycatcher occurrence within or near the LSA. Baseline studies for Olive-sided Flycatcher consisted of habitat suitability mapping and breeding bird surveys (see Appendix 15-A for detailed information on wildlife baseline studies). The objective of these studies was to confirm presence and distribution of Olive-sided Flycatcher and their suitable habitat within the LSA.

Suitable habitat was mapped using provincial standard methods for habitat mapping outlined in *British Columbia Wildlife Habitat Ratings Standards* (Resources Inventory Committee 1999a). Olive-sided Flycatchers breed in BC (Campbell et al. 1997). Reproductive habitat is considered the most limiting type of habitat, thus it was selected for habitat mapping and analysis for the effects assessment. A species-habitat model was developed to relate Olive-sided Flycatcher habitat requirements to characteristics within the ecosystem mapping, and the model was used to produce a map of habitat suitability. Species models are provided in Appendix 3 in the wildlife baseline report (Appendix 15-A). Field studies were undertaken to confirm the accuracy of assumptions within the species-habitat model, and adjust those assumptions where necessary prior to finalization of the habitat suitability map.

Breeding bird surveys were conducted using provincial standard methods outlined in *Inventory Methods for Forest and Grassland Songbirds* (Resources Inventory Committee 1999b). Initial surveys were conducted in 2008, with additional surveys in 2011 to areas previously not surveyed, as well as to revisit those areas initially surveyed in 2008. Surveys were conducted between late May and mid-July each year, starting at sunrise and continuing no later than four hours after sunrise. Surveys consisted of point count stations at which all birds heard or seen were recorded, including species,

number of individuals observed, sex, age class, activity, and wherever possible the distance and direction from the observer to the bird.

16.4.2.6 Bald Eagle

Prior to baseline studies for the Project, provincial government databases (BC CDC, Wildlife Species Inventory database, and EcoCat) and online public databases (BC Breeding Bird Atlas) were searched for information on Bald Eagle occurrence within or near the LSA. Baseline studies for Bald Eagle consisted of an aerial nest survey and wildlife habitat suitability mapping (see Appendix 15-A for detailed information on wildlife baseline studies). The objective of these studies was to confirm presence and distribution of Bald Eagle and suitable habitat within the LSA.

Suitable habitat was mapped using provincial standard methods for habitat mapping outlined in *British Columbia Wildlife Habitat Ratings Standards* (Resources Inventory Committee 1999a). The Bald Eagle nesting season is considered a sensitive time period for the species, and nests are protected year-round under the BC *Wildlife Act* (1996b); therefore, suitable habitat mapping and analysis was conducted for nesting habitat. A species-habitat model was developed to relate Bald Eagle nesting habitat requirements to characteristics within the ecosystem mapping, and the model was used to produce a map of habitat suitability. Habitat suitability models are provided in Appendix 3 of the baseline report (Appendix 15-A). Field studies were undertaken to confirm the accuracy of assumptions within the species-habitat model, and adjust those assumptions where necessary prior to finalization of the habitat suitability map.

An aerial nest survey was conducted following methods outlined in *Inventory Methods for Raptors* (Resources Inventory Committee 2001). Areas rated as moderate or high-rated suitability based upon the results of the wildlife habitat suitability mapping were targeted during the aerial survey. The survey was completed on April 15, 2012. If a large stick nest was observed, its location and occupancy status as well as the species, sex, and age class of the occupants were recorded.

16.4.2.7 Northern Goshawk

Prior to baseline studies for the Project, provincial government databases (BC CDC, Wildlife Species Inventory database, and EcoCat) and online public databases (BC Breeding Bird Atlas) were searched for information on Northern Goshawk occurrence within or near the LSA. Baseline studies for Northern Goshawk consisted of a call playback survey and wildlife habitat suitability mapping. (see Appendix 15-A for detailed information on wildlife baseline studies). The objective of these studies was to confirm presence and distribution of Northern Goshawks and their suitable habitat within the LSA.

Suitable habitat was mapped using provincial standard methods for habitat mapping outlined in *British Columbia Wildlife Habitat Ratings Standards* (Resources Inventory Committee 1999a). Northern Goshawk nesting habitat preferences are more selective than general living or foraging habitat, so nesting habitat was chosen for modelling. A species-habitat model was developed to relate Northern Goshawk habitat requirements to characteristics within the ecosystem mapping, and the model was used to produce a map of habitat suitability. Habitat suitability models are provided in Appendix 3 of the baseline report. Field studies were undertaken to confirm the accuracy of assumptions within

the species-habitat model, and adjust those assumptions where necessary prior to finalization of the habitat suitability map.

Call-playback surveys followed methods outlined in *Inventory Methods for Raptors* (Resources Inventory Committee 2001). Survey stations were placed in proximity to suitable habitat. Each transect was surveyed twice, with the first visit occurring during the nesting period (June 1 to 30) and the second visit during the fledgling-dependency period (July 1 to August 31). Surveys were completed between 30 minutes after sunrise and 30 minutes before sunset. Call-playback units broadcast a recording of an adult goshawk alarm call (if during the nesting period) or a juvenile goshawk begging call (if during the fledgling-dependency period) to elicit a response from any goshawks in the area. If a raptor was observed, the sex, age class, distance and direction of that individual was recorded.

16.4.2.8 Bats

Prior to baseline studies for the Project, provincial government databases (BC CDC, Wildlife Species Inventory database, and EcoCat) were searched for information on bat occurrence within or near the LSA. Five target species were identified: fringed myotis, little brown myotis, northern myotis, Townsend's big-eared bat, and western small-footed myotis. All five target species were sampled using two separate methods within the LSA: acoustic sampling and mist-netting. The objective of these studies was to confirm presence and distribution of bats within the LSA.

Acoustic sampling with remote detectors was conducted in a variety of bat foraging habitats potentially affected by the Project including riparian, grassland, and vegetated openings at low to high elevations. The old Weyerhaeuser mill site was also sampled. In total, eight sites were sampled over July and August 2011, and an additional 10 sites were sampled over June, July, and August 2012. Species identification from calls is possible for many species, given good-quality calls and an experienced analyst. Details of the acoustic sampling program are provided in the baseline report (Appendix 15-A).

Bat capture and handling methods were generally consistent with both *Inventory Methods for Bats* (Resources Inventory Committee 1998a) and *Live Animal Capture and Handling Guidelines for Wild Mammals, Birds, Amphibians and Reptiles* (Resources Inventory Committee 1998e) but were modified to be consistent with the most recent version of US Fish and Wildlife Service guidelines (US Fish and Wildlife Service 2011) for minimizing the possibility of transmission of white-nose syndrome (US Geological Survey 2011). Mist-netting took place on July 4 to 9 and August 8 to 12, 2012 at nine sites. Nets were placed near wetlands, ponds, marshes and seepage areas, where roads crossed creeks, near bridges, in wet meadows, wet fields, and forest gaps. Data recorded for each captured bat included species (Nagorsen 2002), gender, age (as determined from the degree of ossification of finger joints), weight, reproductive condition, and forearm length (Resources Inventory Committee 1998a).

16.4.2.9 Fisher

Prior to baseline studies for the Project, provincial government databases (BC CDC, Wildlife Species Inventory database, and EcoCat) were searched for information on fisher occurrence within or near the LSA. Baseline studies for fisher presence within the LSA consisted of snow-tracking surveys

(see Appendix 15-A for detailed information on wildlife baseline studies). The objective of these studies was to confirm presence and distribution of fisher within the LSA.

Surveys for fisher tracks were conducted concurrently with ungulate track surveys. Snow-track survey protocol followed recommended methodologies outlined in the *Standards for Ground-based Inventory Methods for Ungulate Snow-track Surveys* (Resources Inventory Committee 2006) with tracks of other wildlife, including fishers, recorded when they were encountered. Highly-suitable fisher habitat generally consists of mature to old forests with moderate to high canopy closure. Aerial photos and field reconnaissance were used to stratify habitats into young or old forested habitats within the ICH and ESSF. Transects were laid out to focus sampling on these two habitat types within the LSA and RSA. Snow-tracking surveys took place on March 20 to 22, 2008 and March 30 to April 2, 2011. Tracks were identified to species (where possible), and the age of the track was estimated.

16.4.2.10 Wolverine

Prior to baseline studies for the Project, provincial government databases (BC CDC, Wildlife Species Inventory database, and EcoCat) were searched for information on wolverine occurrence within or near the LSA. Baseline studies for wolverine use of the LSA were characterized using snow-tracking surveys and road density analysis (see Appendix 15-A for detailed information on wildlife baseline studies). The objective of these studies was to confirm presence and distribution of wolverines and their suitable habitat within the LSA.

Surveys for wolverine tracks were conducted concurrently with ungulate track surveys. Snow-track survey protocol followed recommended methodologies outlined in the *Standards for Ground-based Inventory Methods for Ungulate Snow-track Surveys* (Resources Inventory Committee 2006) with tracks of other wildlife, including wolverine, recorded when they were encountered. Snow-tracking surveys took place on March 20 to 22, 2008 and March 30 to April 2, 2011. Any wildlife tracks encountered were identified to species (where possible), and the age of the track was estimated.

Anthropogenic disturbance plays a significant role in wolverine presence within an area, as they typically avoid all human activities (Copeland et al. 2007; John Krebs, Lofroth, and Parfitt 2007). Road density was used as an index of anthropogenic disturbance within the LSA, because most of the roads are actively used by forestry, recreational users, travelers (driving between the towns of Vavenby and Barriere) and other users. Road density analysis methods are described in Section 16.5.1 and Appendix 15-A).

16.4.2.11 Grizzly Bear

Prior to baseline studies for the Project, provincial government databases (BC CDC, Wildlife Species Inventory database, and EcoCat) were searched for information on grizzly bear occurrence within or near the LSA. Baseline studies for grizzly bear use in the LSA were completed using three methods: 1) habitat suitability mapping; 2) den surveys; and 3) road density analysis (see Appendix 15-A for detailed information on wildlife baseline studies). The objective of these studies was to confirm presence and distribution of grizzly bears and their suitable habitat within the LSA and RSA (den surveys).

Suitable habitat was mapped in the LSA using provincial standard methods for habitat mapping outlined in *British Columbia Wildlife Habitat Ratings Standards* (Resources Inventory Committee 1999a). Grizzly bear habitat selection is primarily driven by forage availability in the growing season. To capture this, feeding habitat was mapped for spring, summer and fall seasons. A species-habitat model was developed to relate grizzly bear habitat requirements to characteristics within the ecosystem mapping, and the model was used to produce a map of habitat suitability. Wildlife-habitat models are provided in Appendix 3 of the baseline report (Appendix 15-A). Field studies were undertaken to confirm the accuracy of assumptions within the species-habitat model, and adjust those assumptions where necessary prior to finalization of the habitat suitability map.

Helicopter surveys were conducted in 2012 in the RSA to search for animal tracks, den excavations, and other evidence of wildlife use along steep slopes near the tree line where grizzly bears typically den. A larger area was used to survey for grizzly dens due to their wide-ranging nature and the distance they can travel between denning habitat and growing season habitat. Three surveys were conducted: two in April during the early spring period when bears are emerging from their dens and one in July immediately following snowmelt (Appendix 15-A). When wildlife sign was observed, the species (if possible), UTM coordinates, age/sex (if possible), number observed, and type of sign were recorded.

Grizzly bears can be particularly susceptible to the effects of road density and related use (Apps and Hamilton 2002; Ross 2002). A road density analysis (see Section 16.5.1 for methods) was conducted to determine the current road density within the LSA as part of the characterization of road disturbance for grizzly bear and other species (Figure 16.4-1).

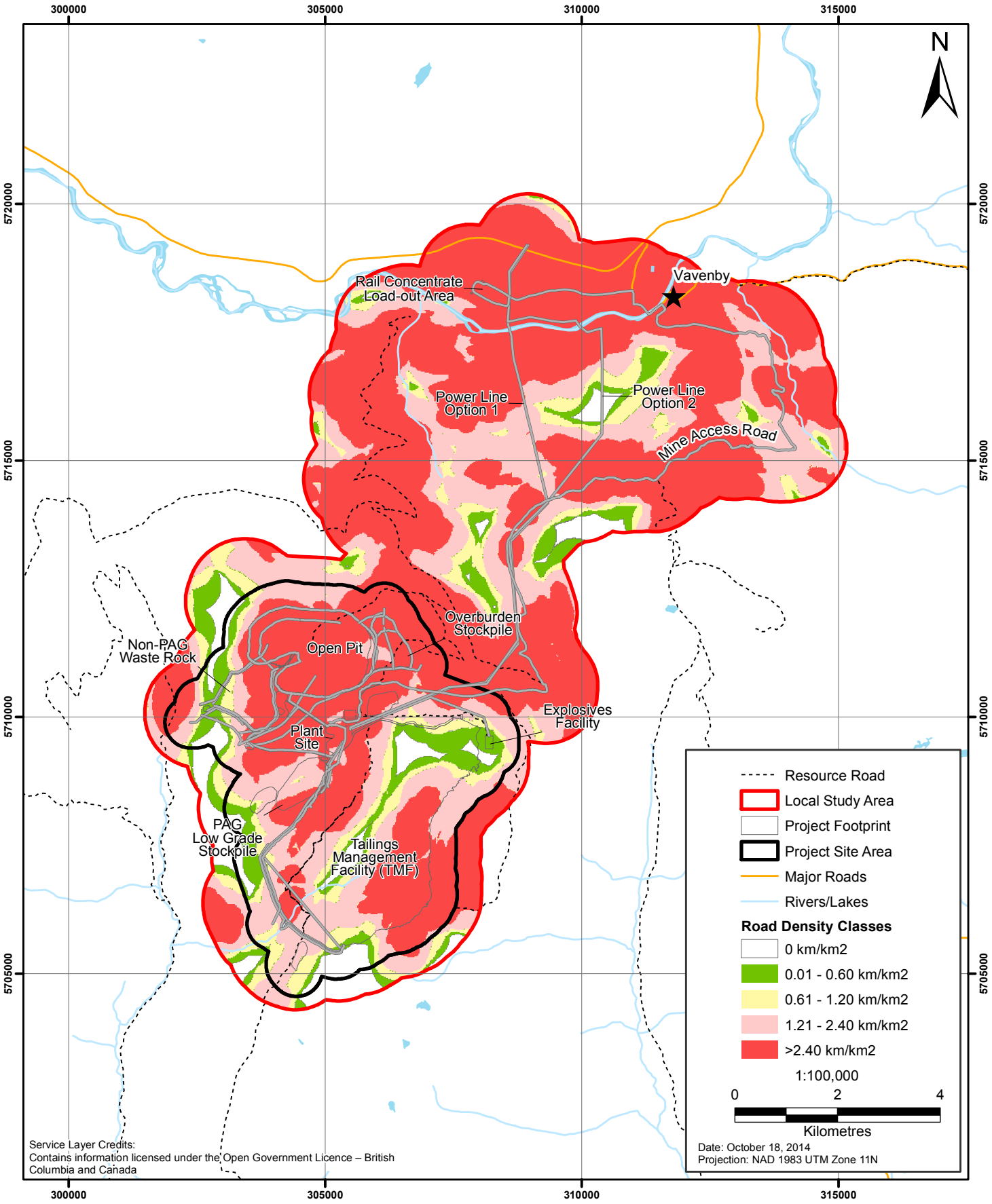
16.4.2.12 Moose

Prior to baseline studies for the Project, provincial government databases (BC CDC, Wildlife Species Inventory database, and EcoCat) were searched for information on moose occurrence within or near the LSA. Baseline studies for moose use in the LSA and RSA were characterized using three methods: 1) habitat suitability mapping; 2) review of existing CMWR; and 3) snow-tracking surveys (see Appendix 15-A for detailed information on wildlife baseline studies). The objective of these studies was to confirm presence and distribution of moose and their suitable habitat within the LSA and RSA.

Suitable habitat was mapped in the LSA using provincial standard methods for habitat mapping outlined in *British Columbia Wildlife Habitat Ratings Standards* (Resources Inventory Committee 1999a). A species-habitat model was developed to relate moose summer feeding, security and thermal habitat requirements to characteristics within the ecosystem mapping, and the model was used to produce a map of habitat suitability.

Habitat mapping for moose winter habitat has been conducted by the British Columbia Ministry of Environment (BC MOE), who identified CMWR. The CMWR was analyzed to determine how much of this area overlaps with the LSA. Spatial files of the CMWR were overlaid with spatial files of the LSA to determine the area of CMWR within the LSA.

Figure 16.4-1
Current Road Density in the Local Study Area



Snow-tracking surveys were conducted to assess moose presence and use of the LSA and RSA in the winter. Survey protocol followed recommended methodologies outlined in the *Standards for Ground-based Inventory Methods for Ungulate Snow-track Surveys* (Resources Inventory Committee 2006). Aerial photos and field reconnaissance were used to stratify habitats into young or old forested habitats within the ICH and ESSF. Transects were laid out to focus sampling on these two habitat types within the LSA and RSA. Snow-tracking surveys took place on March 20 to 22, 2008 and March 30 to April 2, 2011. Tracks were identified to species (where possible), and the age of the track was estimated.

16.4.2.13 Mountain Caribou

Prior to baseline studies for the Project, provincial government databases (BC CDC, Wildlife Species Inventory database, and EcoCat) were searched for information on mountain caribou occurrence within or near the LSA. Baseline studies for mountain caribou use in the LSA were characterized using three methods: 1) habitat suitability mapping; 2) snow-tracking surveys; and 3) road density analysis (see Appendix 15-A for detailed information on wildlife baseline studies). The objective of these studies was to confirm presence and distribution of mountain caribou and their suitable habitat within the LSA.

Suitable habitat was mapped within the LSA using provincial standard methods for habitat mapping outlined in *British Columbia Wildlife Habitat Ratings Standards* (Resources Inventory Committee 1999a). Mountain caribou feeding habitat was mapped for four seasons (early winter, late winter, spring, and summer/fall), as well as security/thermal habitat. A species-habitat model was developed to relate mountain caribou habitat requirements to characteristics within the ecosystem mapping, and the model was used to produce a map of habitat suitability. Field studies were undertaken to confirm the accuracy of assumptions within the species-habitat model, and adjust those assumptions where necessary prior to finalization of the habitat suitability map. Species-habitat models are provided in Appendix 3 of the baseline report (Appendix 15-A).

Snow-tracking surveys were conducted to assess mountain caribou use of the LSA and RSA in the winter (see Appendix 15-A). Survey protocol followed recommended methodologies outlined in the *Standards for Ground-based Inventory Methods for Ungulate Snow-track Surveys* (Resources Inventory Committee 2006). Aerial photos and field reconnaissance were used to stratify habitats into young or old forested habitats within the ICH and ESSF. Transects were laid out to focus sampling on these two habitat types within the LSA and RSA. Snow-tracking surveys took place on March 20 to 22, 2008 and March 30 to April 2, 2011. Tracks were identified to species (where possible), and the age of the track was estimated.

Southern mountain caribou avoid roads and other linear features because they are a source of mortality (through vehicle collisions and increased predator access), disturbance (through increased human access and use), and habitat alteration (Environment Canada 2014). Road density analysis for mountain caribou followed the same methods described in Section 16.5.1 and Appendix 15-A.

16.4.2.14 Mule Deer

Prior to baseline studies for the Project, provincial government databases (BC CDC, Wildlife Species Inventory database, and EcoCat) were searched for information on mule deer occurrence within or near the LSA. Baseline studies for mule deer use of the LSA were characterized by snow-tracking

surveys and the review of existing CDWR (see Appendix 15-A for detailed information on wildlife baseline studies). The objective of these studies was to confirm presence and distribution of mule deer and their suitable habitat within the LSA.

Survey protocol followed recommended methodologies outlined in the *Standards for Ground-based Inventory Methods for Ungulate Snow-track Surveys* (Resources Inventory Committee 2006). Snow-tracking surveys took place on March 20 to 22, 2008 and March 30 to April 2, 2011. Tracks were identified to species (where possible), and the age of the track was estimated.

Habitat mapping for mule deer winter habitat has been conducted by the BC MOE, who identified CDWR. The CDWR mapping obtained from the BC MOE was analyzed to determine how much of this area overlaps with the LSA. Spatial files of the CDWR were overlaid with spatial files of the LSA to determine the area of CDWR within the LSA (Appendix 15-A).

16.4.3 Existing Conditions

16.4.3.1 Western Toad

The western toad is widespread in BC, occurring from the Rocky Mountains to the Pacific coast (BC MWLAP 2004b). The western toad is one of the few amphibians that can inhabit alpine habitats and it is absent only from the most arid areas (ibid.). Declines in western toad populations have been observed throughout their range, including in some relatively "pristine" areas (BC MWLAP 2004b). The reasons for these declines are not well understood but isolation, disease, pesticide poisoning, competition with introduced species (e.g., American bullfrog *Lithobates catesbeianus*), road mortality, and habitat loss from urban development, pollutants, road development and forestry are all believed to be contributing factors (Ministry of Water Land and Air Protection 2004; Slough 2004; BC CDC 2014a).

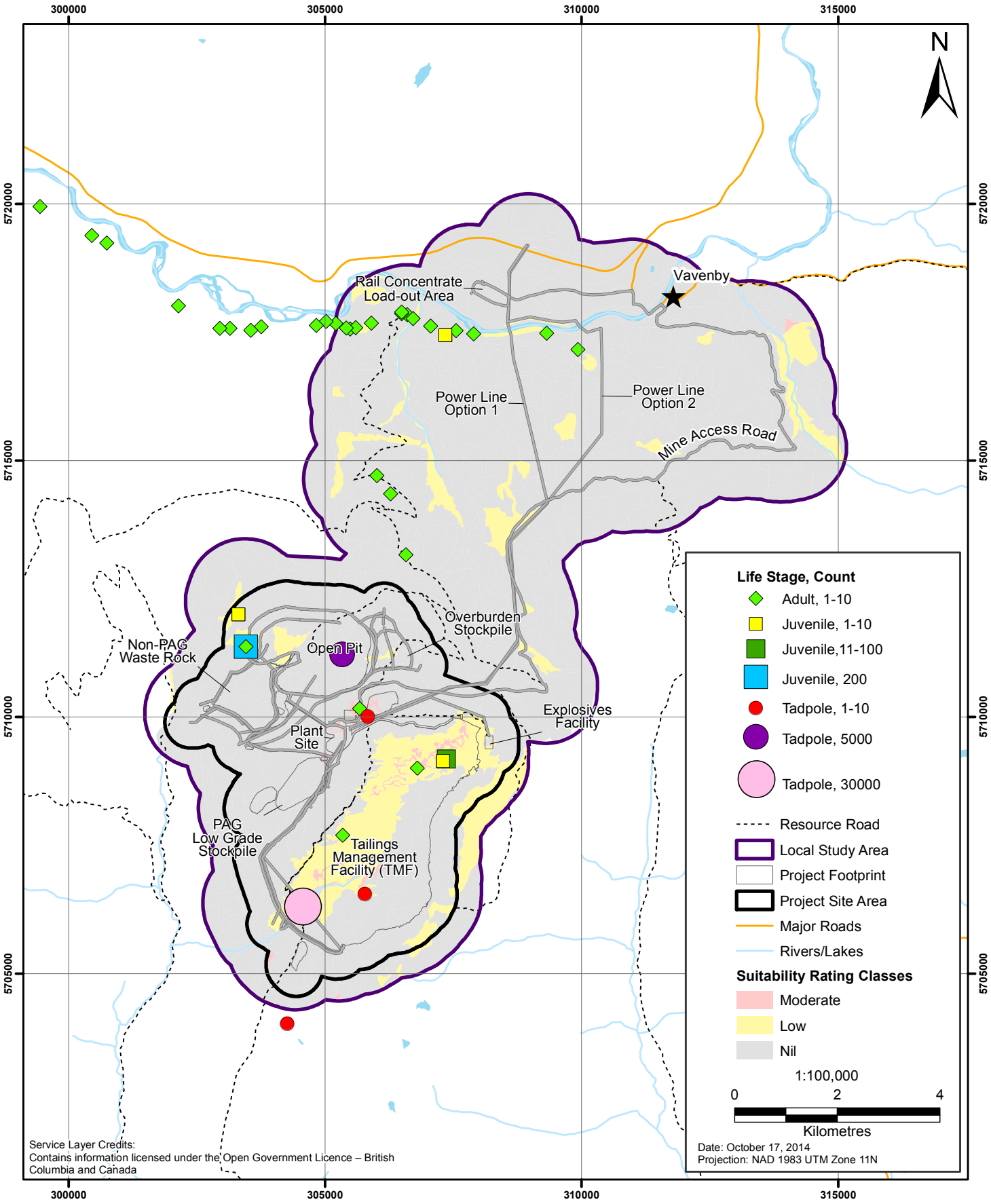
Western toads breed in permanent or temporary water including wetlands, ponds, stream edges, shallow lake margins, ditches and road ruts (Olson 1992; Reimchen 1992; Corkran and Thoms 1996; Gyug 1996). A total of 72.0 ha of suitable western toad reproduction habitat was mapped in the LSA (Figure 16.4-2). Much of this habitat is located at the Project Site due to the presence of a plateau, which has allowed the formation of numerous wetland complexes. None of the habitat in the LSA was rated as high suitability in the models; however, suitable habitat was confirmed in the LSA during field surveys, as several breeding ponds were observed (see below).

During baseline road encounter surveys, six juvenile and five adult western toads were observed crossing the Jones Creek FSR at various elevations. Twenty-five toads were also observed along Birch Island Road, at low elevation within the LSA.

During time-constrained pond surveys, western toad tadpoles were observed at five locations within the LSA, all within the Project footprint (Figure 16.4-2). Two hundred juveniles were observed within a wetland at the south end of the TMF footprint and the open pit footprint. A wetland at the south end of the TMF footprint contained an estimated 30,000 tadpoles. Several incidental observations of western toad were made during other surveys within the LSA. These observations were of adult and juvenile western toads, primarily at small wetlands within the Project Site (Figure 16.4-2).

Figure 16.4-2

Western Toad Observations and Habitat Suitability



Western toads occur throughout the LSA, and are considered to be relatively common throughout BC. Breeding sites were confirmed at higher elevations, within the Project Site and in particular within the TMF. It is expected that additional breeding sites are available at lower elevations, based on habitat suitability mapping and typical dispersal distances of western toads compared to observations of adults, but no additional sites were confirmed.

16.4.3.2 Barn Swallow

Man-made structures provide the best opportunities for Barn Swallow nesting. A total of 279.6 ha of suitable (high- and moderate-rated) Barn Swallow nesting habitat was mapped in the LSA (see Appendix 15-A for more information on suitability ratings). This habitat is located at the north end of the LSA, in and around the town of Vavenby where buildings and other structures are available (see Appendix 15-A).

No Barn Swallows were identified during breeding bird surveys in 2008 and 2011. Six Barn Swallows were observed incidentally during baseline surveys, all at low elevations along the North Thompson River Valley.

16.4.3.3 Common Nighthawk

The Common Nighthawk is found across all regions of the province except the central and north coasts, and in all BGC zones except those in the alpine. Nesting habitats are open, sparsely vegetated areas, usually surrounded by forest. Foraging on flying insects occurs above nesting habitat as well as above wetlands, rivers, ponds and estuaries (Brigham 1990).

During call-playback surveys in 2012 (25 stations over four transects, approximately 115 minutes of survey effort), 19 adult Common Nighthawks were detected including three pairs and 13 individuals. The majority of nighthawks observed were seen flying over farm fields in the North Thompson River Valley. Four adult nighthawks were detected incidentally feeding over fields during other surveys within the LSA. All Common Nighthawk observations were at low elevations near the North Thompson River.

16.4.3.4 Harlequin Duck

The following results have been summarized from the draft report written by Summit Environmental Consultants Ltd. (2009). Harlequin Duck brood surveys were conducted in the Harper Creek watershed over a three-day period (July 19 to 21, 2008). Suitable habitat along Harper Creek and tributaries was surveyed, but no Harlequin Ducks were detected. Some suitable habitat was identified along Harper Creek and at the confluences of some of the tributaries. The tributaries themselves did not contain any suitable habitat.

16.4.3.5 Olive-sided Flycatcher

Olive-sided Flycatchers are found in coniferous forests across much of North America, and at higher elevations along the Rocky and Coastal Mountain Ranges. Olive-sided Flycatcher populations have shown a decline in North America over the past 40 years (COSEWIC 2007). The cause of this decline

is unknown, but loss of winter habitat, the increasing presence of ecological sinks in breeding habitat, or a reduction in insect prey due to pesticide use have all been suggested as causes (Diamond 1991; Hutto and Young 1999; Altman and Sallabanks 2012).

A total of 3,126.1 ha of suitable (high- and moderate-rated) Olive-sided Flycatcher nesting habitat was mapped in the LSA (see Appendix 15-A for more information on suitability ratings). This habitat is distributed throughout the study area at all elevations.

Six Olive-sided Flycatchers were recorded during baseline breeding bird surveys conducted in 2011, and none were observed during 2008 surveys. Two observations were along the proposed mine access road, and four were within the proposed TMF area. Seven Olive-sided Flycatchers were observed incidentally during other baseline surveys in the Project Site and at lower elevations along the proposed mine access road.

The results of baseline surveys indicate that Olive-sided Flycatchers occur through much of the LSA due to large amounts of available suitable habitat. This species is associated with edges along forest openings, which are very common throughout the LSA as a result of forest harvesting (COSEWIC 2007).

16.4.3.6 Bald Eagle

Bald Eagles occur throughout BC, excluding alpine and subalpine areas, and populations in the province are estimated to be in the range of 20,000 to 30,000 (Gerrard 1983; Farr and Dunbar 1988). A total of 769.3 ha of suitable (high- and moderate-rated) Bald Eagle nesting habitat was mapped in the LSA (See Appendix 15-A for more information on suitability ratings). This habitat is located in the bottom of the North Thompson River Valley where large cottonwood or Douglas-fir trees provide suitable substrates for very large stick nests.

During baseline aerial surveys in 2012, two active Bald Eagle nests were observed in the North Thompson River Valley. One adult Bald Eagle was detected incidentally during baseline surveys, along Birch Island Road near the North Thompson River (Appendix 15-A). Based on the results of baseline studies, Bald Eagle use of the LSA occurs primarily along the North Thompson River Valley.

16.4.3.7 Northern Goshawk

The Northern Goshawk subspecies found within the Project area (*Accipiter gentilis atricapillus*), is Yellow-listed in BC. The Northern Goshawk is considered a habitat generalist; it uses a wide range of habitats and successional stages for meeting its needs (Cooper and Stevens 2000), and has been recorded in almost every forest type in the province (Campbell et al. 1990). However, Northern Goshawks are primarily nest in mature or old-growth coniferous forests (Cooper and Stevens 2000).

A total of 3,471 ha of suitable (high- and moderate-rated) Northern Goshawk nesting habitat was mapped in the LSAs (see Appendix 15-A for more information on suitability ratings). The majority of this habitat is located at lower elevations where the forest structure and tree species are suited to supporting the large stick nests of goshawks.

No Northern Goshawks were detected during 7 hours and 22 minutes of call play-back studies in 2011, and 5 hours and 11 minutes of call-playback surveys in 2012. Two adult Northern Goshawks were incidentally observed along the upper Jones Creek FSR, and along Resource Road 5 on the plateau.

Based on nesting habitat suitability mapping, Northern Goshawks are expected to occur at the lower elevations of the IDF and ICH within the LSA. However, goshawks will also use higher elevation sites (e.g., incidental observation of a goshawk in the ESSF during baseline surveys). It is expected that this habitat use is primarily for feeding, as foraging habitat requirements are much less stringent than nesting habitat requirements (Squires and Reynolds 1997; Cooper and Stevens 2000).

16.4.3.8 Bats

Fringed myotis, little brown myotis, and northern myotis were confirmed to be present within the LSA from the results of acoustic sampling and baseline capture studies (see Appendix 15-A for more information on sampling effort and time). Fringed myotis appears to be present in low densities within the LSA; one was recorded acoustically, and one was captured along the valley bottom of the North Thompson River. Little is known about specific habitat requirements of fringed myotis, although they are thought to forage in arid grasslands, dry ponderosa pine and Douglas-fir forests, and riparian areas (Rasheed, Garcia, and Holroyd 1995; COSEWIC 2004). These types of habitats are only found at low elevations in the LSA.

The little brown myotis and northern myotis are much more common and were detected throughout the LSA. Acoustic recordings and capture detections of each of these species occurred throughout the study area, in a variety of habitats at low and high elevations.

16.4.3.9 Fisher

Three sets of fisher tracks were recorded in the LSA during 2011 baseline snow-tracking surveys. Appendix 15-A shows the locations of snow tracking transects, though the exact locations of the tracks were not recorded (see Appendix 15-A for details of snow-tracking surveys). Two of these were recorded in the Project Site, while the third was observed along the Harper Creek FSR.

16.4.3.10 Wolverine

Wolverines are habitat generalists that use several habitats throughout the year within home ranges that can be very large (Hornocker and Hash 1981; Gardner 1985; Magoun 1985; Whitman, Ballard, and Gardner 1986; Banci 1987; J. A. Krebs and Lewis 2000), with reported values ranging from 76 km^2 (Banci and Harestad 1990) to 1,582 km^2 (Copeland 1996). However, the one exception is denning habitat (Hatler 1989; BC MWLAP 2004a). Natal den sites are generally located at or near the treeline (Copeland and Yates 2008) in open (i.e., non-forested), high-elevation cirque basins, or forested ravines (Copeland 1996; Magoun and Copeland 1998; J. A. Krebs and Lewis 2000; BC MWLAP 2004a), with deep snow cover (Magoun and Copeland 1998a; Aubry, McKelvey, and Copeland 2007). Most of the LSA is dominated by closed-canopy forests, with the exception of the ESSFwcp (parkland) at the southern tip, as the elevation climbs towards alpine habitats further outside the LSA. The dominance of closed-canopy forests limits the potential for wolverine denning within the LSA.

During baseline studies, four sets of wolverine tracks were observed along the Harper Creek FSR. Wolverines generally avoid human activities (e.g., Carroll et al. 2001, Rowland et al. 2003, May et al. 2006, all as cited in (Copeland et al. 2007; John Krebs, Lofroth, and Parfitt 2007), and the presence of high road density (see Section 16.4.3.11; Table 16.4-1) throughout the LSA permits easy access for many users. This easy access likely has some displacement effect on wolverine baseline distribution.

16.4.3.11 Grizzly Bear

Grizzly bears occur at all elevations from sea level to the alpine and they are found in all BGC zones except the Bunchgrass and Coastal Douglas-fir. Habitat loss, alteration, and human-caused mortalities (e.g., hunting, poaching, traffic collisions, and nuisance animal kills) are the primary factors limiting grizzly bear populations in BC (BC MWLAP 2004a). The grizzly bear is provincially Blue-listed, is an Identified Wildlife species under FRPA, and has been designated as a species of special concern by COSEWIC (BC CDC 2014). The LSA is within the Columbia-Shuswap Grizzly Bear Population Unit (GBPU). This GBPU is classified as viable by the BC Government and was estimated in 2012 to have 346 grizzlies, and a density of 20 to 30 bears per 1,000 km^2 (BC MFLNRO 2012a). The portion of the GBPU within which the LSA is located was closed to grizzly bear hunting in 2012 (ibid.).

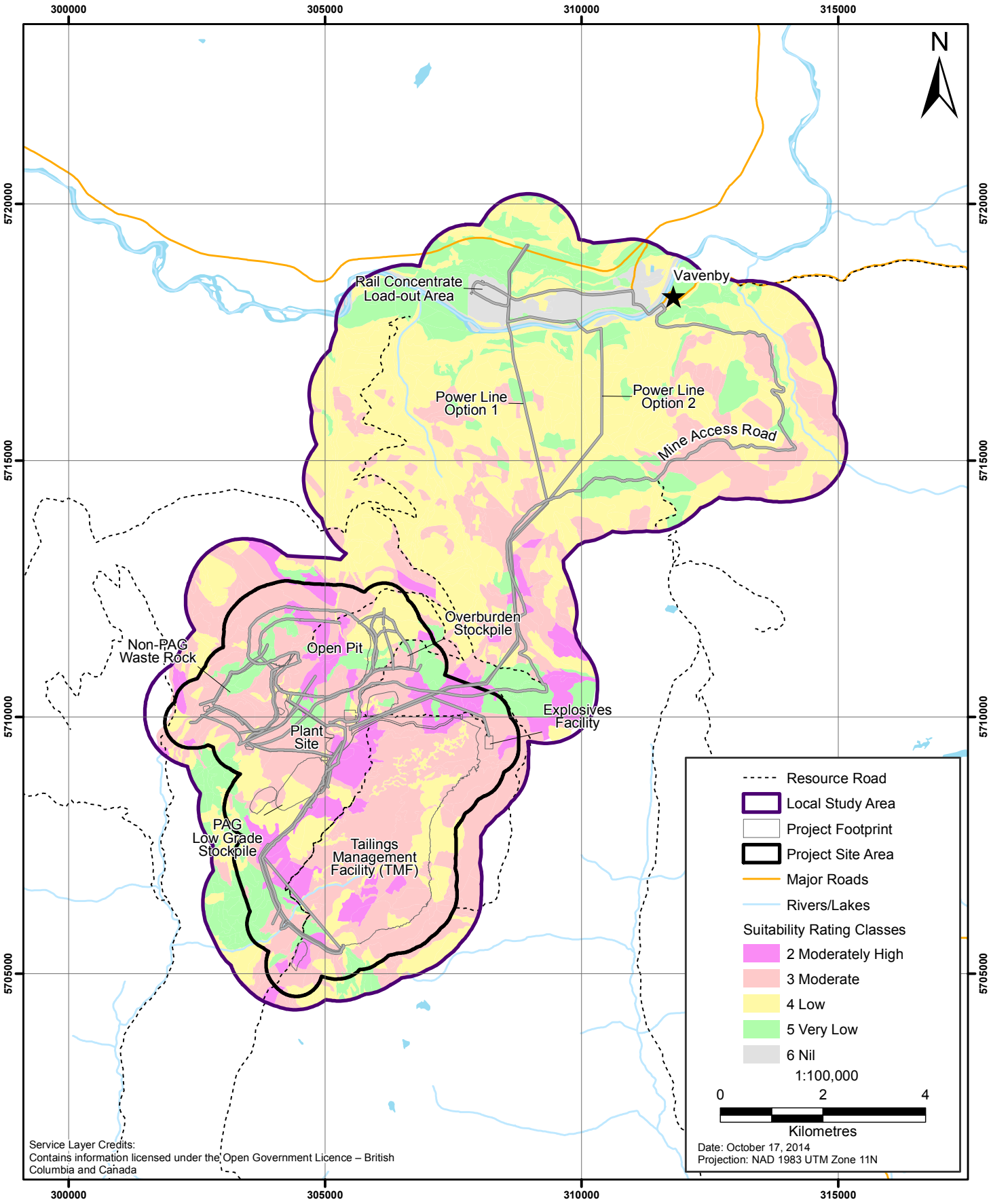
At total of 120.1 ha of suitable (class 1 to 3) habitat for grizzly bear spring feeding, and a total of 2,230 ha of suitable summer feeding habitat were mapped within the LSA. A total of 4,393.6 ha of suitable fall feeding habitat was identified at higher elevations in the LSA (Figure 16.4-3; see Appendix 15-A for more information on habitat suitability ratings).

The LSA experiences a late snowmelt, with upper elevations within the ESSF sometimes not snow free until well into June or later. This limits potential spring bear forage to low elevations, which within the LSA are dominated by human presence around the town of Vavenby. These factors combine to limit spring grizzly bear forage opportunities. Summer grizzly feeding within the LSA is mapped as berry-producing habitats, avalanche slopes, and higher-elevation wetlands. Suitable fall habitat for grizzly bear is mainly located at higher elevations in the LSA for the presence of late-summer and early-fall berry crops, and small mammal prey in high-elevation meadows.

Grizzly bear tracks were recorded at an unknown location within the LSA during baseline surveys by Summit in 2008 (Summit Environmental Consultants Ltd 2009), and one set of grizzly bear tracks was recorded along a road during baseline surveys by Keystone in 2011. Although there is potentially suitable habitat in the LSA, use of the LSA is limited, as demonstrated by the lack of sightings or evidence of use during baseline surveys, as well as by First Nations (Simpc'w First Nation 2012).

One den was located in Dunn Peak Protected Area (outside of the LSA) where grizzly tracks leaving the den could be seen in the snow. No dens were found within the LSA. Grizzly bears typically den on steep slopes at high elevations, near the treeline (Gyug, Hamilton, and Austin 2004). Most of the LSA is located below the treeline. Therefore, although denning has been confirmed at one location in an area adjacent to the LSA, no suitable denning habitat is present within the LSA itself.

Figure 16.4-3
Grizzly Bear Habitat Suitability Modelling Results – Fall Habitat



Baseline road analysis (see Appendix 15-A for details of road-density analysis and Section 16.5.1) resulted in a high (1.21 to 2.40 km/km²) or very high (over 2.40 km/km²) baseline road density for 81.7% of the LSA (Table 16.4-1). This high density may negatively affects grizzly bear use in the LSA, as grizzly bears typically avoid areas with high road densities (Apps and Hamilton 2002; Ross 2002).

Table 16.4-1. Road Densities in the Local Study Area

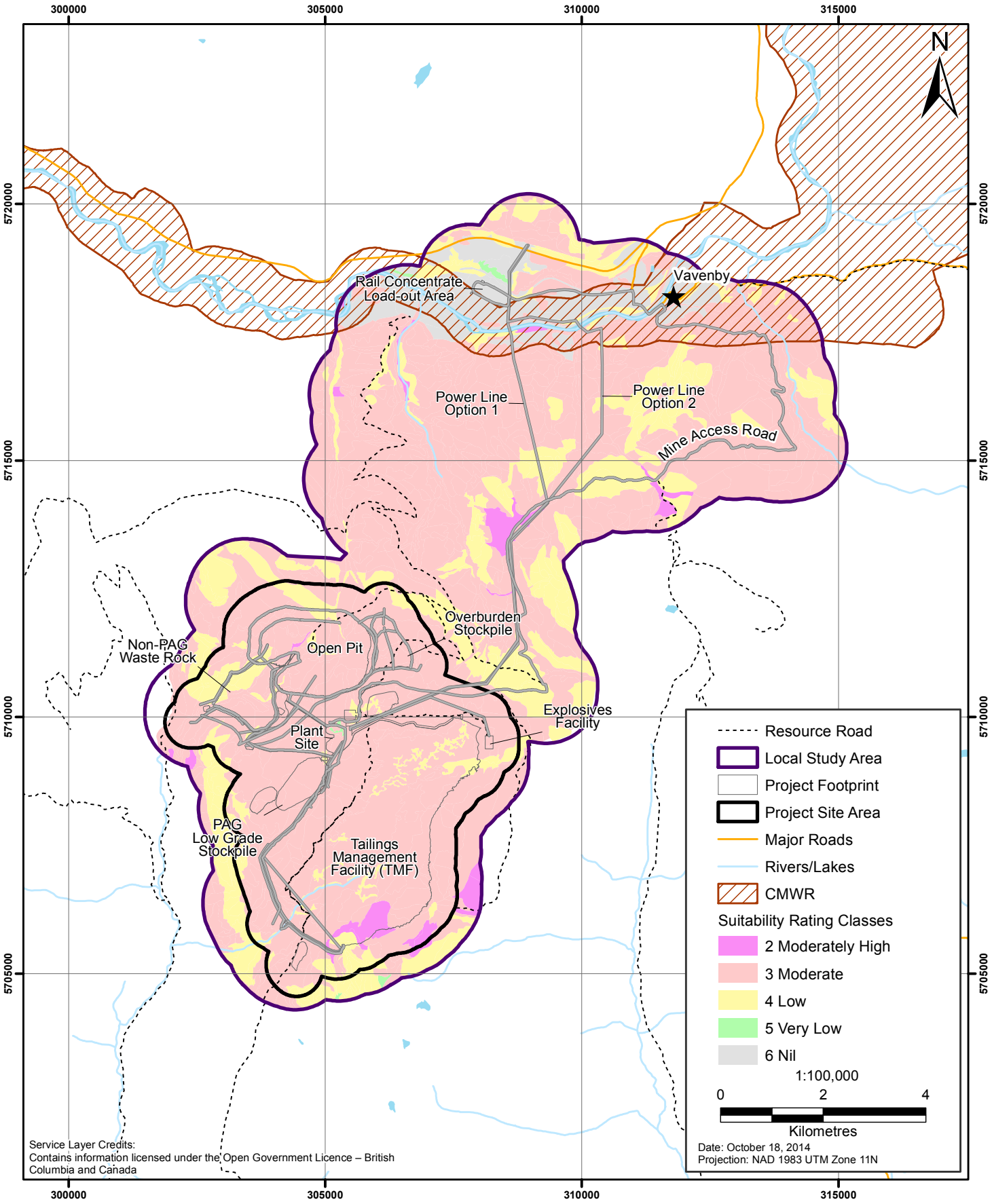
Road Density Rating	Road Density (km/km²)	Area (ha)	Percent of Total
None	0	538.6	4.9
Low	0.01-0.60	646.3	5.8
Moderate	0.61-1.20	841.5	7.6
High	1.21-2.40	2,783.0	25.1
Very High	> 2.40	6,275.1	56.6

16.4.3.12 Moose

Moose distribution within the LSA appears to vary seasonally. During the winter, snow conditions typically limit moose to lower-elevation areas in the ICH and IDF, where the CMWR has been designated. According to CMWR analysis, a total of 1,012.5 ha of CMWR is located within the LSA, all at low-elevation areas along the North Thompson River Valley (see Appendix 15-A for details of habitat modelling). Snow depths greater than 90 cm can severely restrict moose movement in an area (Ungulate Winter Range Technical Advisory Team 2005), and depths within the ESSFwc2 can typically be 200 to 300 cm. This is consistent with observations made during winter track surveys, where all moose tracks observed were along lower-elevation survey transects.

During the growing season, moose are expected to be dispersed throughout the LSA. Security/thermal habitat is common in the LSA and likely not limiting, but growing season forage habitat is more restricted. Higher-suitability foraging habitat was identified in the shrubby wetlands located within the proposed TMF footprint. Based upon results of habitat suitability mapping, growing season feeding habitat for moose is limited within the LSA, mainly restricted to higher elevation shrubby wetlands. In total, 72.6 ha of suitable (class 1 to 3) growing season feeding habitat for moose were identified (Figure 16.4-4). Moose are primarily browsers, and many of the wetlands and meadows within the LSA are dominated by herbaceous vegetation that makes them less suitable for feeding. However, suitable (class 1 to 3) security/thermal habitat for moose in the growing season is common throughout the LSA. A total of 8,201.6 ha of suitable habitat (74.4% of the LSA) were identified. According to CMWR analysis a total of 1,012.5 ha of CMWR are located within the LSA, all at low-elevation areas along the valley bottom of the North Thompson River (Figure 16.4-4).

Figure 16.4-4
Moose Growing Season Security/Thermal Habitat and Critical Moose Winter Range



16.4.3.13 Mountain Caribou

Five life requisites were mapped for mountain caribou habitat suitability as a part of the baseline. Four of these were seasonal feeding habitats, to reflect changing distribution and availability of forage throughout the year (Table 16.4-2; see Appendix 15-A for more information on habitat suitability ratings). Early winter foraging habitat was mapped primarily at mid-elevations within the LSA, with approximately 2,101.7 ha of suitable (class 1-3) habitat available within the LSA. Late winter foraging habitat is very common in the LSA due to the presence of old-growth forest and the opportunities it provides for lichen forage. Late-winter habitats were mapped at higher elevations than early-winter habitats, reflecting the movement of caribou to areas where deeper snow improves access to arboreal tree lichens. A total of 3,168.2 ha of suitable (class 1-3) late-winter feeding habitat was mapped in the LSA (Table 16.4-2; Figure 16.4-5). During the spring, caribou move back to lower elevations to obtain fresh, green vegetation in the first areas free of snow. A total of 1,684.2 ha of suitable (class 1-3) habitat was mapped for this season. Summer/fall habitat is the least common feeding habitat in the LSA (629.1 ha of suitable [class 1-3] habitat), as many caribou will move up towards the treeline in this season, or concentrate in higher-elevation sites with lush herbaceous vegetation. Security/thermal habitat within the LSA is common, with 4,232.2 ha of suitable (class 1-3) habitat available. It is distributed throughout the LSA, wherever mature or old forest is present.

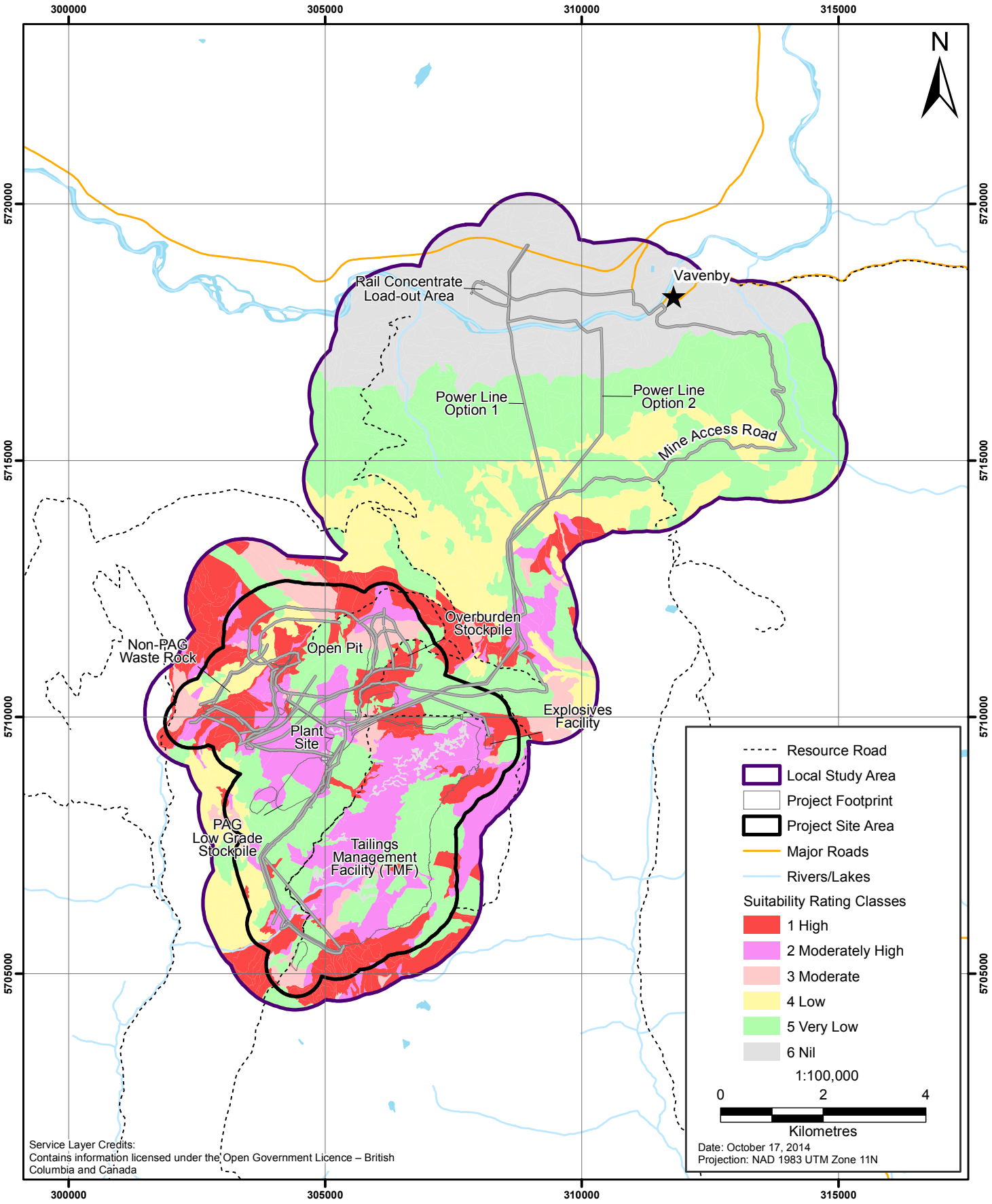
Table 16.4-2. Area (ha) of Suitable Mountain Caribou Habitat in the LSA

Class	Feeding – Early Winter	Feeding – Late Winter	Feeding - Spring	Feeding - Summer/Fall	Security/Thermal
1	51.3	1,442.7	0.0	22.9	1,546.1
2	1,645.1	1,271.4	238.6	91.4	1,118.9
3	405.3	454.1	1,445.6	514.8	1,567.2
4	3,517.4	1,618.8	6,472.0	7,302.1	3,626.9
5	5,107.7	4,083.7	2,570.6	992.0	2,867.7
6	294.5	2,150.6	294.5	2,098.1	294.5
Total	**11,021.3**	**11,021.3**	**11,021.3**	**11,021.3**	**11,021.3**

No caribou tracks were observed during baseline snow-tracking surveys. An incidental observation of caribou tracks was reported at an unspecified location along Harper Creek FSR by Summit (2009), and two additional potential tracks were recorded in the LSA by Keystone. It was not confirmed if these were in fact tracks; therefore, caribou use of the LSA is likely limited and remains unknown.

The results of the road density analysis showed a high (1.21-2.40 km/km^2) or very high (over 2.40 km/km^2) baseline road density for 81.7% of the LSA (Table 16.4-1). Areas with low or no road density were mainly concentrated along the southern and western boundaries of the LSA and within the area of the proposed TMF footprint (Figure 16.4-1). Caribou are strongly associated with old-growth forests, which comprise almost a third of the LSA. However, much of the old-growth is fragmented by logging and road development, greatly reducing its effectiveness as mountain caribou habitat.

Figure 16.4-5
Mountain Caribou Late Winter Feeding Habitat



16.4.3.14 Mule Deer

During baseline snow-tracking surveys (2008 and 2011) one set of mule deer tracks was observed in 2011 near Saskum Lake FSR (Appendix 15-A). Exact observation locations were not recorded.

Mule deer distribution within the LSA is likely seasonally-dependent and similar to moose. Snow depth has an even greater effect on deer distribution than moose (Ungulate Winter Range Technical Advisory Team 2005) and thus the snow depths within the ESSF are expected to be too deep for deer in most years. Deer are likely concentrated within the CDWR during this time. According to the CDWR analysis a total of 355.6 ha of CDWR is located within the LSA, all at low-elevation areas along the valley bottom of the North Thompson River (Appendix 15-A).

Although not observed in the LSA, mule deer are expected to occur throughout the LSA during the growing season due to their adaptability and diverse habitat preferences (Shackleton 1999).

16.5 POTENTIAL EFFECTS AND MITIGATION

16.5.1 Screening Potential Project Effects

16.5.1.1 Identifying Potential Effects on Wildlife

Potential effects on wildlife and wildlife habitat as a result of the Project have been raised during working group meetings by Aboriginal groups and government, and have been identified through best management practices, scientific literature, and technical expertise/professional judgment. How and when these potential effects may arise due to the Project is summarized in here (Section 16.5.1.1). A detailed description of the potential effects is provided in Section 16.5.1.2 to 16.5.1.4. Each issue is addressed for the wildlife VCs deemed to be of concern in Section 16.6.

From the scoping assessment, the potential effects of the Project on wildlife were divided into three main categories: habitat alteration and loss, disturbance and displacement, and mortality (Table 16.5-1). For more detailed information about the impacts of specific Project components on VCs please see Appendix 16-A, Risk Ratings of Project Effects on Wildlife Valued Components. The three main categories of potential effects and the methodology used for their assessment are summarized below. Mitigation measures to minimize effects are presented in Section 16.5.2 and the analyses and characterizations of the effects on each VC are presented in Section 16.6.

16.5.1.2 Habitat Alteration and Loss

Habitat alteration and loss can cause corresponding changes in the suitability of an area for a given species. The magnitude of the change depends on the species being considered. For large, mobile mammals, a few hectares of habitat loss may be inconsequential. However, that same amount of habitat loss may remove the entire range for species with small home ranges (e.g., amphibians), if adjacent suitable and unoccupied habitat is not available. Some habitat alterations can have positive effects for some species (e.g., vegetation clearing will create edge habitat suitable for Olive-sided Flycatcher), whereas others could have long-lasting negative impacts on habitat viability (e.g., impacts on water quality).

Table 16.5-1. Summary of Potential Project Effects on Wildlife VCs

Potential Effect Category	Potential Effects Considered	Phase in which Potential Effects may Occur		
		Construction	Operations	Closure and Post-Closure
Habitat Alteration and Loss	Habitat Loss	X	X	
	Habitat Alteration: Contaminants	-	-	X
	Habitat Alteration: Dust	-	-	-
Disturbance and Displacement	Road Disturbance	-	-	-
	Noise Disturbance	X	X	-
Mortality	Vegetation Clearing and Building Demolition	X	X	X
	Wildlife-Vehicle Collisions	X	X	-
	Increased Access	-	-	-
	Power Line	X	X	X
	Nuisance Animals	X	X	-

"X" indicates that the potential effect may occur during the identified Project phase
"-" indicates that the effect will not occur as a result of the Project, and is therefore scoped out of the effects assessment or not assessed for a particular phase (details are provided in Sections 16.5.1.2 through 16.5.1.4).

Effects considered under the category of "habitat alteration and loss" include:

- Habitat Loss - direct loss of habitat due to Project infrastructure (i.e., footprint).
- Habitat Alteration: Contaminants – the introduction of contaminants to aquatic or terrestrial habitats.
- Habitat Alteration: Dust – the potential degradation of habitat due to dust deposition.

Habitat Loss

Habitat loss will begin during the Construction phase of the Project (e.g., construction of the Project Site, power line, road widening) and continue into the Operations phase due to footprint expansion (e.g., TMF, open pit). Wherever possible, reclamation activities will be undertaken to restore habitat as practical following Closure. The areas to be reclaimed and reclamation plans are described in Chapter 7, Closure and Reclamation.

The amount of habitat lost for wildlife VCs was calculated by overlaying the assessment footprint on the habitat suitability modelling and/or vegetation mapping (see Appendix 15-A for habitat suitability modelling). For those VCs for which suitability mapping was not done, information from other sources (e.g., CMWR) was used for the assessment. If no information on habitat was available, a qualitative assessment and professional judgment was used.

Direct habitat loss was calculated using habitat suitability models developed for the following eight VCs:

- western toad;

- Barn Swallow;
- Olive-sided Flycatcher;
- Bald Eagle;
- Northern Goshawk;
- grizzly bear;
- moose; and
- mountain caribou.

Habitat suitability mapping was not undertaken for mule deer, fisher, wolverine, bats, Common Nighthawk, or Harlequin Duck. Habitat loss assessments for these species were evaluated qualitatively, if assessed for that VC.

Habitat Alteration: Contaminants

The introduction of Project-related contaminants was identified as a potential habitat-altering effect for wildlife VCs. Wildlife exposed to contaminants of potential concern (COPCs) may be affected if COPCs are taken up into their bodies from the environment, and if concentrations are greater than effect thresholds (i.e., toxicity thresholds, or the concentration that can cause adverse effects in wildlife). This section summarizes the methods used for the assessment of effects due to contamination (see Appendix 16-B, Selection of COPCs and Water Quality Impacts to Wildlife, for further details). The potential for adverse effects to wildlife was assessed following general principles of ecological risk assessment (BC MOE 2005, 2008b; Environment Canada 2012). In order to determine the potential effects of Project-related COPCs on VCs, the following three factors were considered:

1. A wildlife VC receptor has to be present (based on baseline studies, Section 16.4).
2. A pathway must exist from the point of release of the chemical to the wildlife VC receptor and the receptor must be able to take up the chemical (i.e., the chemical must be bioavailable).
3. A COPC has to be present due to Project activities at a sufficiently high concentration to have the potential to cause toxicological effects. Where possible, this was determined quantitatively (e.g., through comparison of water quality model results to BC water quality guidelines [WQG] for wildlife), otherwise qualitative assessment was used.

During the various phases of the Project, wildlife VCs may be exposed to COPCs through two potential sources:

1. Directly in water (e.g., discharge from the TMF).
2. Indirectly via food chain bioaccumulation (i.e., through their diet).

A third source of COPCs that was excluded from the assessment is ingestion of fugitive dust (deposited either in or on soil or vegetation) generated by Project activities. While some uptake of metals via intake of dust deposited on surfaces of soil or vegetation is possible, it is unlikely that any

of the wildlife VCs will be exposed to concentrations of metals high enough to cause adverse effects via this exposure route due to the following factors:

- most fugitive dust will be deposited within disturbed areas or closely adjacent to the Project footprint (see Air Quality Chapter 9); the elevated noise levels and human activity associated with the Project are often within the Project footprint as well, and as a result these areas are not typically used extensively by wildlife due to disturbance, limiting their exposure to fugitive dust;
- many wildlife VCs have large home ranges in which they forage for food, and the area in which dust deposition is predicted to occur is small relative to the size of the home range (e.g., grizzly bears, ungulates, fur bearers);
- the migratory nature or seasonal use of habitat by wildlife VCs means that exposure to deposited dust is seasonal or periodic;
- some dust generation is seasonal (e.g., along the access road, minimal dust during times of snow cover); and,
- dust deposition is weather-dependent (e.g., less dust generation with precipitation such as rain or snow, wind may affect deposition areas or may blow the dust off of vegetation surfaces).

Wildlife VCs Potentially Exposed to Chemicals of Potential Concern

To determine which wildlife VCs may have the potential for residual effects due to exposure to COPCs, the spatial extent of potential changes to the aquatic environment (e.g., due to changes in water quality) was compared to the spatial distribution of the wildlife VC (e.g., based on habitat suitability mapping, or where VCs may be expected to be present). This identified the VCs that might have an operable exposure pathway to COPCs. If wildlife VCs and their habitat are not present in the areas predicted to have elevated COPC concentrations, these wildlife VCs were not considered any further in the effects assessment of the potential for adverse effects. After conducting this scoping exercise, only Harlequin Ducks were considered for the effect of habitat alteration due to contaminants, as COPCs will be limited to lotic (i.e., fast flowing waters of rivers or creeks) environments, which is potential habitat for Harlequin Ducks, even though none were observed during baseline surveys (see Appendix 16-B for further information, and Table 16-B3).

Selection of Contaminants of Potential Concern for Wildlife

Data from the water quality model (expected case and unrecovered seepage sensitivity case) were used to select COPCs during all phases in the open pit, TMF, and the waterways downstream of the Project Site. Modelling nodes (i.e., locations where water quality predictions are made in the water quality model) are described in Chapter 13 and Appendix 13-C, and presented in Figure 13.5-1. The only COPC identified for wildlife was selenium at the P Creek, T Creek, and Harper Creek (HP, HM, HT, and HB) modelling nodes (Table 16-B3 in Appendix 16-B).

The wildlife VCs that could be affected by water quality in the open pit or TMF are primarily migratory birds, amphibians and large mammals, since the ponds may appear as attractive habitat. However, with mitigation (adaptive management will be initiated to discourage wildlife from

accessing the open pit or the TMF if wildlife are regularly observed using these facilities, Section 16.5.2), wildlife exposure to water in the open pit or TMF is expected to be minimal and, therefore, residual effects to wildlife VCs due to COPCs in the open pit or TMF are not predicted with mitigation and are not assessed further.

The potential effect of habitat alteration due to contaminants during the Construction phase was scoped out of the assessment, based on results of the water quality model. No COPCs were predicted to exceed guidelines for wildlife at any of the Harper Creek modelling nodes during seasons when the VCs (i.e., Harlequin Ducks) are present in the receiving environment (Appendix 13-D, Comparison of Predicted Water Quality to Water Quality Guidelines; Appendix 16-B, Selection of COPCs and Water Quality Impacts to Wildlife). Therefore, the assessment of habitat alteration due to contaminants is only assessed for Harlequin Ducks during the Operations, Closure, and Post-Closure phases of the Project (Section 16.6.4).

Habitat Alteration: Dust

Fugitive dust generated by Project-related activities could be dispersed from its place of origin to depositional areas and may accumulate in or on soil and vegetation. This has the potential to alter habitat quality, but results of air quality modelling (Chapter 9) suggest that dust deposition will not affect wildlife habitat.

An air quality model (described in Chapter 9) was developed for the Project for the Construction and Operations phases. Predictions for fugitive dust deposition from the air quality model (Chapter 9) were used to determine the areas that are predicted to potentially be altered due to dust deposition. The highest amount of dust deposition will occur during the Operations phase, when dust may be deposited outside of the footprint (near the pit and along a portion of the access road) at concentrations greater than 1.9 mg/dm^2/day (BC MOE 1979). A small area at the northwest corner of the pit that extends approximately 650 m from the Project footprint (Chapter 9, Predicted Maximum 30-day Dust Deposition) may be altered due to dust deposition, and dust may disperse up to approximately 200 to 300 m along approximately 2 km of the access road (Chapter 9). This amount of alteration is considered negligible (less than approximately 1 km^2 may experience dust deposition); therefore, the effect of habitat alteration due to dust is not discussed further in the assessment.

16.5.1.3 Disturbance and Displacement

Disturbance and displacement from Project-related activities (e.g., noise, and human presence) may alter the behaviours of wildlife species, resulting in behavioural changes or habitat avoidance. Human disturbance may dissuade an animal from using an area or cause stress that changes how an area is used. Disturbance can interrupt normal activity and cause an animal to move away from the source of disturbance. This movement may have energetic costs to the individual, as well as disrupting the activity (e.g., foraging, courting, resting, tending young) of the individual (Gill and Sutherland 2000; Blanc et al. 2006).

The effects considered under the category of "disturbance and displacement" include:

- displacement due to roads and associated activities.

- displacement due to noise (including continuous Project noise and instantaneous blasting noise).
- displacement due to light.

Road Disturbance

Roads are often cited as having an effect of disturbance on wildlife (Jalkotzy, Ross, and Nasserden 1997). Grizzly bear, mountain caribou, and wolverine are all species that can be particularly susceptible to the effects of road density and related use (Apps and Hamilton 2002; Ross 2002). A road density analysis was conducted to determine the current road density within the LSA. Road density was used as a proxy for disturbance, as information on traffic volumes was not available.

A 500 m-radius, raster-based, moving-window analysis was completed to determine the density of roads within the study area. Conceptually, a circle of 500 m radius was drawn around each raster cell. Within the circle all road segments were identified, given equal weight, and their length was measured. The total lengths of all roads within the circle were summed and divided by the circle's area to give a road density. All raster cells were then classified into one of 5 categories (Interagency Grizzly Bear Committee 1994):

1. 0 km/ km^2 – No roads;
2. 0.01 – 0.60 km/ km^2 – Low road density;
3. 0.61 – 1.20 km/ km^2 – Moderate road density;
4. 1.21 – 2.40 km/ km^2 – High road density; or

Over 2.40 km/ km^2 – Very high road density.

The results of the road density analysis showed a pre-existing high (1.21-2.40 km/km^2) or very-high (greater than 2.40 km/km^2) baseline road density for 81.7% of the LSA (see Table 16.4-1). The pre-existing high road density within the LSA may have contributed to the low numbers of mountain caribou, fisher, grizzly bears, and wolverine observed during baseline surveys, and as suggested in the existing literature (Mattson, Knight, and Blanchard 1987; Aune and Stivers 1985 as cited in Jalkotzy, Ross, and Nasserden 1997; Ross 2002). Therefore, this effect is pre-existing in the LSA, and because the Project is not adding additional roads to the LSA, it is not considered further in the Application/EIS.

Noise Disturbance

The effect of noise is expected to occur during the Construction and Operations phases of the Project. The source, duration, and intensity of noise all influence how an animal may respond, whether it is disturbance, displacement, or habituation. The most common response is a behavioural response, where animals may become disturbed and may lose time and energy from key behaviours such as feeding, breeding, or watching for predators, leading to increased energy cost and possibly reduced fitness. A behavioural response can also occur when animals avoid high-quality habitats near disturbance sources resulting in the displacement from that habitat (D. H. Ward et al. 1999; Gibeau et al. 2002; Bautista et al. 2004). Noise can also mask the sounds that animals use to find prey,

mates, and avoid predators. Masking can reduce fitness (breeding success), especially for species that are highly reliant on their acoustic environment. In some cases, habituation and adaptation can allow wildlife to accommodate, and even take advantage of, the presence of noise in their environment.

For the noise disturbance assessment, the area outside of the Project footprint that would be affected by noise was evaluated using noise contours modelled for the Noise Effects Assessment (Chapter 10). The area of wildlife habitat affected was calculated by choosing specific noise level contours from the modelling. Two types of noise were evaluated: 1) Continuous Project noise (55 dBA Ld; 45 dBA Ln and; 2) instantaneous blasting noise (108 dB Lpeak during Construction and Operations). The noise modelling methodology and results are presented in Chapter 10.

The 45 dBA (for Operations phase) and 55 dBA (for Construction phase) noise levels were selected based on chronic noise threshold values identified for birds (47 dBA; Reijnen and Foppen 1994, 1995; Reijnen, Foppen, and Meeuwsen 1996)The Environment Code of Practice for Metal Mines (Environment Canada 2010) recommends that ambient noise from mining operations and its effect on wildlife should meet the objectives for residential areas; the sound pressure level from mining activities should not exceed 55 dBA during the day and 45 dBA at night. During the Construction phase, activities will not occur at night; therefore, the 55 dBA threshold is modelled during the Construction phase. Because activities will occur at night during the Operations phase of the Project, the 45 dBA threshold is used for the assessment of continuous Project noise on wildlife, as this is the more conservative threshold.

The blasting noise threshold level of 108 dB (Lpeak) represents "disturbed habitat" and was selected based on a range of threshold values (85 to 108 dB) identified for mammals resulting in flight response, freezing, or strong startle response (Manci et al. 1988; Weisenberger et al. 1996; Reimers and Colman 2006). Noise modelling considered areas where blasting noise attenuates to 108 dB for instantaneous noise effects.

16.5.1.4 Mortality

Wildlife mortality may result through targeted human actions (e.g., destruction of nuisance bears) but is most commonly an indirect consequence (e.g., loss of active bird nests during forest clearing). Effects that are considered under 'mortality' include:

- mortality resulting directly from clearing and construction activities (e.g., birds, bats, western toads);
- mortality resulting from demolition or renovation of existing buildings and other structures (e.g., Barn Swallows and bats);
- mortality resulting from wildlife-vehicle collisions (e.g., western toads, furbearers, large mammals, ungulates);
- mortality resulting from increased hunting and poaching due to access roads;
- mortality resulting from wildlife interactions with the power line (electrocution; e.g., birds); and
- mortality resulting from destruction of nuisance animals (e.g., furbearers and bears).

The potential for mortality effects to VCs was assessed qualitatively using professional judgement.

Vegetation Clearing and Building Demolition

During construction activities (which may occur during the Construction and Operations phases), some wildlife species such as bats, birds, and western toads, may be susceptible to mortality caused by vegetation clearing or building demolition (e.g., bats and barn swallows). Juvenile furbearers and grizzly bears in dens will not be susceptible to clearing because no denning habitat for grizzly bears, fishers or wolverines was identified in the LSA during baseline surveys (see Vegetation and Wildlife Baseline Report, Appendix 15-A). Clearing trees or vegetation that support active bird nests during construction could also cause mortality of bird species. Bird nests are sensitive elements protected under the *BC Wildlife Act* and the *Migratory Birds Convention Act*. Clearing riparian vegetation and moving large construction machinery near or within riparian areas could cause mortalities of western toads/toadlets.

Alteration or demolition of existing buildings within suitable habitat has the potential to destroy active nests of Barn Swallows if construction occurs during the breeding season. Demolition or renovation of buildings or bridges also has the potential to disturb bats roosting in or on those structures. Mortality effects on bats are likely limited to the growing season (i.e., May to September), since no landscape features that are suitable for bat hibernation were identified in the LSA (Appendix 15-A). Alteration or demolition of buildings could occur during the Construction, Operations, or Closure phases of the Project.

Wildlife-Vehicle Collisions

Wildlife-vehicle collisions are evaluated for the Project access road for large mammals. Wildlife-vehicle collisions can cause mortality for a variety of wildlife species (Vieira 1999; Kerley et al. 2002; Deem and Emmons 2005). Collisions between large animals and vehicles can also have implications for human safety. Many wildlife species in BC are more susceptible to vehicle collisions during certain times of the day and year. Some species are more active at dawn and dusk (crepuscular), while others are more active at night (nocturnal). Most casualties occur near water sources where shrub and vegetation cover is greater, at curves in the road, and during seasons corresponding to highest animal activity (i.e., breeding and dispersing; Drews 1995; Romin and Bissonette 1996; Main and Allen 2002; Nielsen, Anderson, and Grund 2003; E. Lee et al. 2004; Saeki and MacDonald 2004; Guter et al. 2005; Hell et al. 2005). Wildlife may also be attracted to roads due to de-icing salts, attractive roadside vegetation, and as a travel corridor, further increasing the likelihood of vehicle-wildlife interactions. In some cases, animals (e.g., moose and deer) can become trapped on ploughed roads where high snow banks prevent exit from the road surface. Wildlife road kills could attract carnivores such as furbearers and bears to the roads to scavenge on the carcasses, thus potentially putting these animals at risk of interacting with vehicles (Jalkotzy, Ross, and Nasserden 1997; Kispiox Sustainable Resource Management Plan 2003; MacHutchon and Mahon 2003).

Wildlife-vehicle collisions were not considered for birds or bats.

Increased Access

The Project will be accessed by existing public roads, including FSRs. The envisaged route via the Vavenby Mountain FSR, Saskum Plateau FSR and the Vavenby-Saskum FSR will be widened and its alignment improved to accommodate concentrate haulage and Project Site traffic. An approximately 2.5-km long section of road will be constructed from the intersection of the Saskum Plateau FSR and the Vavenby-Saskum FSR within the Project Site. Access to and around the area near the Project Site is not being altered, and therefore the effect of increased access and potential increased mortality due to hunting is not considered further in the effects assessment.

Power Line

Power lines may cause direct mortality of birds through collisions and electrocutions (Donald A. Blood and Anweiler 1994). Birds with larger wingspans, such as raptors, are most vulnerable to collisions because they are less manoeuvrable (APLIC 2006). Collision risk is generally associated with:

- the design of the power lines (e.g., those with wires at multiple levels pose a greater risk);
- species-specific physiology (e.g., size or manoeuvrability);
- behaviour (e.g., flying in flocks vs. singly);
- bird population densities (e.g., areas with greater bird use pose a greater potential for collisions to occur); and
- habitat (e.g., bisecting important migratory paths poses a greater risk of collisions (Dorin and Spiegel 2005)).

Electrocution from power lines results when a bird completes a circuit by simultaneously contacting an energized wire (i.e., conductor) and another energized wire or utility pole. Given the expected configuration of the power line as a single wooden pole design, there is a minor potential for electrocution if raptors perch on the cross-arm of the pole. The power line will be designed and constructed to appropriate industry standards taking into consideration measures to minimize potential effects on raptors due to electrocution as described in Section 16.5.2.

Mortality of Nuisance Animals

Habituated bears or furbearers generally encounter humans more frequently and may become conditioned to associate human beings with food sources (Stephen Herrero et al. 2005) and can exhibit less avoidance behaviour (Jalkotzy, Ross, and Nasserden 1997). Wildlife may be attracted to site during Construction and Operations when the majority of human activities will take place, but this effect is not expected to continue into Closure or Post-Closure, when human activity has ceased.

Improper storage and/or disposal of garbage, especially food wastes, may attract wildlife to construction sites and operating mine sites (Mining and Petroleum Environmental Research Group 2008). Odours causing attractants can potentially affect bears and furbearers. Odours are particularly problematic for bears. The presence of odours poses indirect risks as they can draw animals to populated areas where they become habituated to people. Habituated wildlife can pose a threat to

the safety of both humans and wildlife (i.e., attacks) and often necessitates wildlife relocation or destruction.

16.5.2 Mitigation Measures

A Wildlife Management Plan (WMP) has been developed for the Project (Section 24.19). This section summarizes mitigation measures to reduce Project effects. Further information can be found in Section 24.19.

16.5.2.1 Mitigation for Habitat Alteration and Loss

Effects considered under the category of "habitat alteration and loss" include habitat loss, habitat alteration due to contaminant, and habitat alteration due to dust (See Section 16.5.1.2). Mitigation measures for habitat loss and habitat alteration are presented separately.

Mitigation for Habitat Loss

As a part of Project design to date, some footprints proposed early in the design were altered to reduce effects to sensitive locations. Impacts to old-growth forest and wetlands that provide habitat for several wildlife VCs were avoided when a large stockpile footprint originally located to the northwest of the pit was eliminated from the revised Project design.

Mitigation for direct habitat loss may vary for each VC species. Project mitigation for habitat will include, but is not limited to:

- avoidance of important habitat where practicable alternatives are available; and
- re-vegetation/reclamation of some Project components during Closure.

Mitigation for Habitat Alteration due to Contaminants

To minimize the potential effects to habitat due to contaminants, adaptive management will be initiated to discourage wildlife from accessing the open pit or the TMF if wildlife are observed using these facilities. Furthermore, the following management plans will be followed:

- Air Quality and Dust Management Plan (Section 24.2)
- Emergency Response Plan (Section 24.4)
- Explosives Handling Plan (Section 24.5)
- Fuel and Hazardous Materials Management Plan (Section 24.7);
- Selenium Management Plan (Section 24.12)
- Site Water Management Plan (Section 24.13)
- Spill Prevention and Response Plan (Section 24.15); and
- Waste Management Plan (Section 24.18).

Mitigation for Habitat Alteration due to Dust

To minimize the potential effects to habitat due to dust, the following management plans will be followed:

- Air Quality and Dust Management Plan (Section 24.2); and
- Vegetation Management Plan (Section 24.17).

16.5.2.2 Mitigation for Disturbance and Displacement

Mitigation for disturbance and displacement includes noise and light mitigation measures.

Noise Mitigation

During Construction and Operations, wildlife may be disturbed due to noise (e.g., traffic, mill processing, blasting etc.). A Noise Management Plan (Section 24.10) will be developed with the objective to ensure that noise levels during all phases of the Project are acceptably low for human and wildlife receptors, as per human health guidelines (Health Canada 2011). Examples of noise mitigation measures relevant to wildlife include:

- considering noise ratings when selecting equipment;
- adjusting blasting configurations to minimise simultaneous blasting effects;
- ensuring impulse events, such as blasting, will be limited to certain times of the day;
- optimizing the operation of equipment to minimize noise, e.g., reducing vehicle speeds;
- optimizing the site layout to minimize noise impact, e.g., through use of natural screens such as buildings, locating doors away from noise sources and facing away from relevant receptors;
- housing stationary sources in buildings and conducting loud procedures indoors, where practical; and
- noise dampening measures will be applied where practical.

Light Mitigation

The mine facilities are likely to be lit continuously during night-time for worker safety considerations. This increases the potential for effects on wildlife, which will be mitigated by using directed/focused lighting, where practical and without compromising safety of employees, rather than broad area lighting and by shielding lights to minimize stray light. Lighting in non-essential areas will be used only when necessary, without compromising safety of employees.

16.5.2.3 Mitigation for Mortality

Effects considered under the category of "mortality" include vegetation/building clearing, vehicle collisions, power lines, and nuisance animals (See Section 16.5.1.4). Mitigation measures for these four components of mortality are presented separately.

Mitigation for Vegetation Clearing and Building Demolition

To minimize the potential effect of direct mortality to wildlife due to vegetation clearing and/or building demolition, Project mitigation will include, but is not limited to:

- Vegetation clearing activities will be avoided in identified toad breeding ponds from May through August, unless pre-clearing surveys are conducted. If tadpoles or toadlets are observed, these sites will be adaptively managed (e.g., buffer zones or relocation).
- To ensure compliance with the *Migratory Birds Convention Act*, active bird nests will not be disturbed or destroyed during site clearing for infrastructure. Vegetation clearing activities will be scheduled outside of the general breeding bird period (early May to mid-August), unless pre-clearing surveys for nests are conducted.
- If raptor nests are encountered, species-specific buffers will be established around the nest following recommended best management, or the appropriate regulators will be consulted regarding potential relocation of nests.
- Buildings will not be demolished during the bat roosting season (May through September) unless pre-clearing surveys confirm that the buildings are not occupied by bats.

Mitigation for Wildlife-Vehicle Collisions

Vehicle-related mortality will be mitigated through implementation of the Traffic and Access Management Plan (Section 24.16). Project mitigation will include, but is not limited to:

- yielding to wildlife observed along Project roads, subject to personal judgement and safety considerations;
- identifying locations of frequent wildlife use;
- minimizing traffic along roads by providing a vehicle parking lot for staff, and mine personnel will be bused from this site to the mine; and
- making appropriate provisions along Project roads to facilitate wildlife movement without risk of collisions, if necessary (e.g., toads).

Mitigation for Power Lines

To minimize effects on raptors, HCMC will engage the services of a qualified utility contractor to design and construct the power line. The power line will be designed and constructed to appropriate industry standards taking into consideration measures to minimize potential effects on raptors due to electrocution, including measure such as maintaining minimum horizontal and vertical clearances between energized and grounded components.

Mitigation of Attractants to Prevent Mortality of Nuisance Animals

Mitigation of attractants typically takes a two-tiered approach. First, positive behavioural stimuli are removed, such as limiting high-quality forage on road verges or limiting wastes on-site. Second, if wildlife are still attracted to the feature, then negative reinforcement is used to dissuade them from returning.

Examples of mitigation strategies that are designed to reduce the effect of mortality on wildlife VCs due to attraction to site and nuisance animals, will include, but are not limited to:

- managing waste to minimize attractants as per the Waste Management Plan (Section 24.18).; and
- a wildlife component will be included in employee indoctrination and training to ensure their awareness and understanding of the rationale for the recommended wildlife mitigation measures and procedures.

16.6 PREDICTED RESIDUAL EFFECTS AND CHARACTERIZATION

This section identifies and characterizes the potential residual effects on wildlife VCs as a result of the Project. Residual effects are those effects predicted to remain after the application of mitigation measures. From the scoping assessment, three potential effect categories were identified: habitat alteration and loss, disturbance and displacement, and mortality. Mitigation measures to minimize potential effects were discussed in Section 16.5.2. Potential residual effects, after consideration of the mitigations, are described in the following sections for each wildlife VC, followed by a characterization (Table 16.6-1) and evaluation of likelihood for each residual effect, and a summary of residual effects on wildlife (Section 16.6-14). Significance determinations for each wildlife VC and a discussion of confidence and uncertainty in the determination are presented in Section 16.7.

The characterization and likelihood process considered results of wildlife baseline studies (Appendix 15-A), regional planning documents, and scientific literature. A detailed description of the effects assessment methodology, logic, variables, and descriptors are found in Chapter 8 (Table 8.6-2), Assessment Methodology. The residual effects were characterized according to the wildlife-specific criteria provided in 1. All of these criteria were assessed to determine the significance of each residual effect (Section 16.7). In the majority of cases, professional judgement was also employed through a qualitative approach to assist in the determination of significance.

Likelihood refers to the probability of the predicted residual effect occurring and is determined according to the attributes identified in Table 16.6-2.

16.6.1 Western Toad

16.6.1.1 Risk Ratings for Potential Effects

Western toads were assessed for potential Project-related effects. Habitat alteration and loss, and mortality were considered for the effects assessment because those effects have the potential to create a residual effect on western toad. The effect of disturbance and displacement was scoped out of this assessment because it is determined to have no interaction with western toad. Noise disturbance is not considered a potential effect on western toads because the population within Northwest BC is considered a subpopulation of western toads known as the non-calling population (COSEWIC 2012a) which are not sensitive to increased noise levels. Therefore, the effect of disturbance on western toads was not assessed.

Table 16.6-1. Definitions of Characterization Criteria for Wildlife

Timing* *When will the effect begin?*	**Magnitude** *The severity of change relative to baseline conditions*	**Geographic Extent** *The geographic area in which an effect of a defined magnitude occurs*	**Duration** *The length of time required until the VC returns to baseline conditions, or the effect can no longer be measured or otherwise perceived*	**Frequency** *The number of times during the Project or phase that an environmental effect may occur*	**Reversibility** *The ability of the affected VC to return (or be returned) to baseline conditions*	**Resiliency** *Resiliency of the receiving environment or population? Will VC be able to adapt to or absorb the change?*
Construction Phase	**Negligible:** <1% change from baseline, no detectable change	**Discrete:** effect is limited to the Project Site.	**Short term:** effect lasts less than 2 years (e.g., during the Construction phase of the Project).	**One time:** effect is confined to one discrete event.	**Reversible:** effect can be reversed.	**High:** the receiving environment or population has a high natural resilience to imposed stresses, and can respond and adapt to the effect.
Operations Phases (Stages 1 and 2)	**Low:** Less than 10% change from baseline, within the range of natural variation (Andrén 1994).	**Local:** effect is limited to the LSA or equivalent area.	**Medium term:** effect lasts from 2 to 30 years (i.e., encompassing both stages of the Operations phase).	**Sporadic:** effect occurs rarely and at sporadic intervals.	**Partially reversible:** effect can be partially reversed.	**Neutral:** the receiving environment or population has a neutral resilience to imposed stresses and may be able to respond and adapt to the effect.
Closure Phase	**Medium:** Between 10-30% change from baseline, may exceed the limits of natural variation (Swift and Hannon 2010).	**Regional:** effect occurs throughout the RSA.	**Long term:** effect lasts from 30 to 37 years (i.e., effects last into the Closure phase).	**Regular:** effect occurs on a regular basis.	**Irreversible:** effect cannot be reversed, is of permanent duration.	**Low:** the receiving environment or population has a low resilience to imposed stresses, and will not easily adapt to the effect.
Post-Closure Phase	**High:** Greater than 30% change from baseline, beyond guideline (Andrén 1994).	**Beyond regional:** effect extends beyond the RSA.	**Future:** effect lasts more than 37 years (i.e., effects last into the Post-Closure phase and beyond).	**Continuous:** effect occurs constantly.		

Table 16.6-2. Attributes of Likelihood of Effects

Probability Rating	Quantitative Threshold
High	> P80 (effect has > 80% chance of effect occurring)
Moderate	P40 - P80 (effect has 40 - 80% chance of effect occurring)
Low	< P40 (effect has < 40% chance of effect occurring)

The potential residual effects considered in the assessment for western toads are summarized in Table 16.6-3, and described in the following sections, from Section 16.6.1.3 to 16.6.1.4.

Table 16.6-3. Risk Ratings of Project Effects on Western Toads

Potential Effect Category	Potential Effects Considered	Phase in which Potential Effects may Occur		
		Construction	Operations	Closure and Post-Closure
Habitat Alteration and Loss	Habitat Loss	🟡	🟡	
Disturbance and Displacement	Noise Disturbance			
Mortality	Vegetation Clearing and/or Building Demolition			
	Wildlife-Vehicle Collisions	🟡	🟡	🟢
	Power Line	🟡	🟡	🟢
	Nuisance Animals			

Notes:
blank = No interaction expected; no monitoring required, no further consideration warranted.
🟢 *= Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; if minor, may require monitoring; may warrant further consideration.*
🟡 *= Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*
🔴 *= Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

16.6.1.2 Residual Effects

Table 16.6-4 provides a summary of mitigation measures for western toad, effectiveness of mitigation, and whether there is a residual effect after mitigation. The potential residual effects are described below in the following sections.

16.6.1.3 Western Toad Habitat Alteration and Loss

Habitat loss due to the Project footprint is assessed for western toads. Habitat alteration due to contaminants is not considered an effect for western toads. The habitat where contaminant levels above guidelines for wildlife may be encountered is within lotic environment (i.e., flowing waterbody) and is not considered suitable for western toads.

Table 16.6-4. Proposed Mitigation Measures and their Effectiveness for Western Toad

Western Toad			
Potential Effects	**Proposed Mitigation Measure**	**Effectiveness** *(Low, Moderate, High, Unknown)*	**Potential Residual Effect** *(Y/N)*
Habitat Alteration and Loss	Reclamation of wetlands; creation of pocket wetlands.	Unknown	Y
Disturbance and Displacement	N/A	N/A	N
Mortality	Traffic reduction and imposed speed limits; avoid destruction of breeding sites; additional mitigation if necessary.	Moderate	Y

The assessment of habitat loss due to the Project focuses on suitable breeding habitat for western toads. Western toads require a variety of terrestrial and aquatic habitats to complete the different stages of their life cycle. Spring breeding requires aquatic sites such as ponds, lakes, quiet stream sides, and other wetland areas, while summer foraging and winter hibernation occur in terrestrial habitat. Suitable breeding habitat was mapped using TEM during baseline studies (Section 16.4.3.1 and Appendix 15-A).

A total of 72 ha of suitable habitat (habitat ranking high (H) and moderate (M)) was identified in the LSA, primarily within the Project Site. Breeding sites were confirmed (i.e., observations of tadpoles and toadlets) during baseline surveys at higher elevations, within the Project Site and in particular within the footprint of the proposed TMF.

Of the 72 ha of suitable western toad breeding habitat in the LSA, 53.1 ha (74%) will be lost during Construction, and an additional 4.1 ha (6%) will be lost during Operations (Table 16.6-5)

Table 16.6-5. Western Toad Habitat Loss due to the Project Footprint

VC	Total Suitable Habitat Available in LSA (ha)	Project Phase	Total Suitable Habitat Lost in LSA (ha)	Percent of Total Suitable Habitat Lost in LSA (%)
Western Toad	72.0	Construction	53.1	73.8
		Operations	4.1	5.7

The majority of breeding habitat lost during construction (48 ha of the 53 ha lost during Construction) is due to the TMF footprint, where the majority of wetlands in the LSA are found. During Closure and Post-Closure, reclamation of some wetlands (approximately 17.6 ha) is proposed (Chapter 7), and "pocket wetland" breeding sites will be created during Construction and/or Operations to mitigate the effect of habitat loss on western toads (Section 24.19, Wildlife Management Plan). Despite mitigation, a residual effect of habitat loss on western toads is predicted due to the wetlands and known breeding sites located within the proposed Project footprint.

Characterization and Likelihood of Western Toad Habitat Alteration and Loss

Habitat alteration and loss is predicted to result in a residual effect for western toads due to the loss of suitable breeding wetlands. Table 16.6-6 characterizes the residual effect of habitat alteration and loss on western toads.

Table 16.6-6. Characterization of Residual Effect of Habitat Loss on Western Toad

Criterion	Characterization	Explanation
Magnitude	Medium	Before mitigation, the Project will affect approximately 57 ha of the mapped western toad breeding habitat within the LSA (72 ha identified, 79% of which may be lost). Reclamation will create approximately 17.6 ha of wetland habitat, and "pocket wetland" creation for western toads will also contribute to reducing the magnitude of the effect. Due to uncertainties with the TEM predictions of suitable wetland availability and therefore loss within the footprint, monitoring (Section 16.8.7) will be initiated to determine how many breeding sites may actually be lost due to the TMF and pit footprint. With this mitigation, the magnitude of the effect is considered Medium.
Geographic Extent	Discrete	Habitat alteration will only occur within Project footprints (i.e., the Project Site).
Frequency	Sporadic	Habitat alteration will occur sporadically. The majority of habitat will be lost during construction (53 ha), but an additional 4 ha will be lost during the Operations phase.
Duration	Future	Effects to western toad habitat loss will last beyond the life of the Project.
Reversibility	Partially- Reversible	Effects to western toad will be partially reversible, dependent upon the success of wetland reclamation within the LSA during Closure.
Resiliency	Neutral	Western toads are considered to have a neutral resilience to imposed stresses and they may be able to respond and adapt to the effect by breeding in other wetlands.

The probability of habitat loss occurring is considered high (effect has >80% chance of effect occurring; Table 16.6-2), as the location of the Project footprint and western toad breeding habitat is documented and was assessed quantitatively.

16.6.1.4 Western Toad Mortality

The potential sources of western toad mortality in association with the Project will be mortality resulting from collisions with vehicles during Construction and Operations, and due to heavy machinery use for clearing activities in western toad habitat during the Construction phase.

Vegetation Clearing

Direct mortality could occur due to impacts from heavy machinery involved in Project-related construction or vehicles moving through the area. Toads utilize a variety of terrestrial habitats including all forest and woodland types. If Construction is occurring during the breeding season, it may also affect toad breeding ponds. Mitigation will include pre-clearing surveys at known breeding

sites (Appendix 15-A) if clearing activities are scheduled to occur in those areas between May and August. Despite mitigation, a residual effect of mortality due to clearing activities is predicted.

To mitigate potential direct mortality effects on toads, pre-clearing surveys would be conducted on any ponds that would be affected by construction during the breeding (May) and emergence periods (mid-July to mid-August) to identify western toad breeding ponds. Use of machinery and associated Construction phase activities (i.e., tree felling) would be avoided at identified breeding ponds during those periods.

Vehicle Collisions

Direct mortality of western toads as a result of increased traffic is expected to occur during Construction and Operations near roads and close to wetlands during the spring and late summer. Both high- and low-traffic roads can cause mortality, particularly during breeding migrations to and from breeding ponds from upland terrestrial habitat. Mitigation efforts may be able to reduce direct mortality due to vehicle collisions through warning signs for vehicles and the identification of migratory pathways and subsequent mitigation measures. Despite mitigation, a residual effect of mortality due to vehicle collisions is predicted.

Characterization and Likelihood of Western Toad Mortality

Mortality is predicted to result in a residual effect for western toads due to vegetation clearing activities during Construction and vehicle collisions during Construction and Operations. Table 16.6-7 characterizes the residual effect of mortality on western toads.

Table 16.6-7. Characterization of Residual Effect of Mortality on Western Toad

Criterion	Characterization	Explanation
Magnitude	Low	Mitigation should reduce the number of road mortalities and adaptive management will be implemented to ensure the magnitude of the effect remains low.
Geographic Extent	Discrete	Impacts of road mortality and vegetation clearing is expected to be limited to the Project footprint.
Frequency	Regular	The effect is may occur regularly during the Construction phase due to clearing activities and during Construction and Operations due to vehicle collisions – however the effect is limited to the breeding season (May to August).
Duration	Long-term	Effects to western toad may last into the Closure phase, but not beyond.
Reversibility	Reversible	The main source of mortality from high use of roads and construction activities will end on Project completion.
Resiliency	Low	Western toads are considered to have a low resilience to mortality because they are listed on Schedule 1 of SARA, and they may not easily adapt to the effect.

The probability of mortality occurring is considered moderate (effect has 40 – 80% chance of effect occurring; see Table 16.6-2) during Construction and Operations, but should cease during Closure and Post-Closure phases.

16.6.2 Barn Swallow

16.6.2.1 Risk Ratings for Potential Effects

Barn Swallows were assessed for potential Project-related effects. Habitat alteration and loss, and mortality were considered for the effects assessment; however, neither effect is considered residual after mitigation (Section 16.6.2.3 and 16.6.2.4 provides further information). The effect of disturbance and displacement was scoped out of the Barn Swallow assessment because it is determined to have no interaction with Barn Swallows. Noise disturbance is not considered a potential effect because this species is fairly tolerant of human activity, particularly given their habit of nesting on human structures.

The potential residual effects considered in the assessment for Barn Swallow are summarized in Table 16.6-8, and described in the following sections, from Section 16.6.2.3 to 16.6.2.4.

Table 16.6-8. Risk Ratings of Project Effects on Barn Swallow

Potential Effect Category	Potential Effects Considered	Phase in which Potential Effects may Occur		
		Construction	Operations	Closure and Post-Closure
Habitat Alteration and Loss	Habitat Loss	●	●	●
Disturbance and Displacement	Noise Disturbance			
Mortality	Vegetation Clearing and/or Building Demolition	●	●	●
	Wildlife-Vehicle Collisions			
	Power Line			
	Nuisance Animals			

Notes:
blank = No expected; no monitoring required, no further consideration warranted.
● *= Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; if minor, may require monitoring; may warrant further consideration.*
● *= Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*
● *= Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

16.6.2.2 Residual Effects

Table 16.6-9 provides a summary of mitigation measures for Barn Swallow, effectiveness of mitigation, and whether there is a residual effect after mitigation. The potential residual effects are described below in the following sections.

Table 16.6-9. Proposed Mitigation Measures and their Effectiveness for Barn Swallow

Barn Swallow			
Potential Effects	**Proposed Mitigation Measure**	**Effectiveness** *(Low, Moderate, High, Unknown)*	**Potential Residual Effect** *(Y/N)*
Habitat Alteration and Loss	Minimizing building removal or alteration.	Moderate	N
Disturbance and Displacement	N/A	N/A	N
Mortality	Modifications or demolition will only occur when bird are not actively nesting.	High	N

16.6.2.3 Barn Swallow Habitat Alteration and Loss

Habitat loss due to the Project footprint is assessed for Barn Swallow. A total of 279.6 ha of suitable habitat (habitat ranking high (H) and moderate (M)) was identified in the LSA during baseline habitat suitability modelling. This suitable habitat was primarily modelled at low elevation sites located at the north end of the LSA, in and around the town of Vavenby where buildings and other structures are available (see Appendix 15-A).

Of the 279.6 ha of suitable Barn Swallow habitat in the LSA, 10.3 ha (4%) will be lost during Construction, and no additional habitat will be lost during Operations (Table 16.6-10). Because of the small amount of habitat that may be lost (10.3 ha), no residual effect due to habitat alteration and loss is anticipated for Barn Swallows.

Table 16.6-10. Barn Swallow Habitat Loss due to the Project Footprint

VC	Total Suitable Habitat in LSA (ha)	Project Phase	Total Suitable Habitat lost in LSA(ha)	Total Suitable Habitat Lost in LSA (%)
Barn Swallow	279.6	Construction	10.3	3.7
		Operations	0.0	0.0

16.6.2.4 Barn Swallow Mortality

The potential source of barn swallow mortality in association with the Project will be mortality resulting from demolition of buildings during Construction, Operations, or Closure if these activities were to occur while birds are present. However, buildings will not be demolished or modified if birds are actively nesting in the structures. Therefore, with mitigation, no residual effect of mortality on barn swallows is anticipated.

16.6.3 Common Nighthawk

16.6.3.1 Risk Ratings for Potential Effects

Common Nighthawks were assessed for potential Project-related effects. Habitat alteration and loss, and mortality were considered for the effects assessment; however, neither effect is considered

residual after mitigation (Section 16.6.3.3 and 16.6.3.4 provides further information). The effect of disturbance and displacement was scoped out of the Common Nighthawk assessment because it is determined to have no interaction with nighthawks, as the majority of suitable habitat is not found near potential noise sources.

The potential residual effects considered in the assessment for nighthawks are summarized in Table 16.6-11, and described in the following sections, from Section 16.6.3.3 to 16.6.3.4.

Table 16.6-11. Risk Ratings of Project Effects on Common Nighthawk

Potential Effect Category	Potential Effects Considered	Phase in which Potential Effects may Occur		
		Construction	Operations	Closure and Post-Closure
Habitat Alteration and Loss	Habitat Loss	●	●	
Disturbance and Displacement	Noise Disturbance			
Mortality	Vegetation Clearing and/or Building Demolition	●	●	
	Wildlife-Vehicle Collisions			
	Power Line			
	Nuisance Animals			

Notes:
blank = No interaction expected; no monitoring required, no further consideration warranted.
● *= Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; if minor, may require monitoring; may warrant further consideration.*
● *= Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*
● *= Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

16.6.3.2 Residual Effects

Table 16.6-12 provides a summary of mitigation measures for Common Nighthawk, effectiveness of mitigation, and whether there is a residual effect after mitigation. The potential residual effects are described below in the following sections.

16.6.3.3 Common Nighthawk Habitat Alteration and Loss

Habitat suitability modelling for Common Nighthawks was not conducted; therefore, the assessment is qualitative for nighthawks. The high elevation of the area around the Project Site makes nesting unlikely for this species. Nighthawks were detected at low elevations in the RSA during baseline studies and suitable sparsely-vegetated nesting habitat is present at the load-out facility. Development of the load-out facility may result in negligible habitat loss for this species. Less than 5% of cultivated fields, urban, rural and exposed soil ecosystems (Common Nighthawk nesting habitat), are expected to be affected by the Project (see Chapter 15, Terrestrial Ecology Effects Assessment). Because of the limited amount of suitable habitat in the Project Site, no residual effect of habitat loss is anticipated for Common Nighthawk.

Table 16.6-12. Proposed Mitigation Measures and their Effectiveness for Common Nighthawk

Common Nighthawk			
Potential Effects	**Proposed Mitigation Measure**	**Effectiveness** *(Low, Moderate, High, Unknown)*	**Potential Residual Effect** *(Y/N)*
Habitat Alteration and Loss	Minimizing vegetation clearing.	Moderate	N
Disturbance and Displacement	N/A	N/A	N
Mortality	Clearing will only occur when nesting birds are not present.	High	N

16.6.3.4 Common Nighthawk Mortality

The amount of Common Nighthawk nesting habitat that could potentially be affected by the Project is very low; therefore, the potential for mortality due to disturbance or destruction of nests is also considered to be low. Mitigation measures will include pre-clearing surveys for nests if clearing activities are scheduled to occur in Common Nighthawk habitat between May and August. With mitigation, no residual effect of mortality on Common Nighthawk is anticipated.

16.6.4 Harlequin Duck

16.6.4.1 Risk Ratings for Potential Effects

Although Harlequin Duck were not found in surveys of the LSA it was assessed for potential Project-related effects, as a conservative measure given suitable habitat was recorded (see Section 4.1.2 of Appendix 15-A). Habitat alteration was considered for the effects assessment (Section 16.6.4.3). The effects of disturbance and displacement and mortality were scoped out of the Harlequin Duck assessment because they are determined to have no interaction with Harlequin Duck because no ducks or suitable habitat were observed within the LSA during baseline surveys (Section 16.4.3.4 and Appendix 15-A).

The potential residual effects considered in the assessment for Harlequin Duck are summarized in Table 16.6-13, and described in the following section (Section 16.6.4.3).

Table 16.6-13. Risk Ratings of Project Effects on Harlequin Ducks

Potential Effect Category	Potential Effects Considered	Phase in which Potential Effects may Occur		
		Construction	Operations	Closure and Post-Closure
Habitat Alteration and Loss	Habitat Loss			
Disturbance and Displacement	Noise Disturbance		●	●

(continued)

Table 16.6-13. Risk Ratings of Project Effects on Harlequin Ducks (completed)

Potential Effect Category	Potential Effects Considered	Phase in which Potential Effects may Occur		
		Construction	Operations	Closure and Post-Closure
Mortality	Vegetation Clearing and/or Building Demolition			
	Wildlife-Vehicle Collisions			
	Power Line			
	Nuisance Animals			

Notes:
blank = No interaction expected; no monitoring required, no further consideration warranted.
● *= Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; if minor, may require monitoring; may warrant further consideration.*
● *= Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*
● *= Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

16.6.4.2 Residual Effects

Table 16.6-14 provides a summary of mitigation measures for Harlequin Duck, effectiveness of mitigation, and whether there is a potential for a residual effect after mitigation. The potential residual effect of habitat alteration is described below in the following section.

Table 16.6-14. Proposed Mitigation Measures and their Effectiveness for Harlequin Duck

Harlequin Ducks			
Potential Effects	Proposed Mitigation Measure	Effectiveness *(Low, Moderate, High, Unknown)*	Potential Residual Effect *(Y/N)*
Habitat Alteration and Loss	Selenium Management Plan	Unknown	Y
Disturbance and Displacement	N/A	N/A	N
Mortality	N/A	N/A	N

16.6.4.3 Harlequin Duck Habitat Alteration and Loss

Harlequin Duck were not recorded during surveys within the LSA. However, as a conservative measure, habitat alteration due to contaminants is assessed for the Harlequin Duck VC. The predicted changes in water quality during Operations (P Creek, HP, and HT modelling nodes), Closure phase (at T Creek, HT, and HB modelling nodes) and Post-Closure phase (T Creek, HT, and HB modelling nodes) have the potential to affect Harlequin Duck health due to bioaccumulation of Se in the aquatic food chain (see Appendix 16-B, Selection of COPCs and Water Quality Impacts to Wildlife, for details). However, potential habitat for Harlequin Ducks was only observed in Harper Creek, and not in the tributaries such as P and T creeks (Section 16.4.3.4 and Appendix 15-A). Therefore, residual effects to Harlequin Duck were only assessed for modelling nodes in Harper

Creek (i.e., HP, HT, and HB). Furthermore, Harlequin Duck may be present in the area only during the breeding season (i.e., May through August); selenium levels that occur during the winter are therefore not considered to interact with Harlequin Duck and are excluded from the assessment (i.e., HB modelling node is excluded as selenium is predicted to be greater than the guideline only during February and/or March). The potential for habitat alteration due to contaminants is assessed for Harlequin Ducks in upper Harper Creek (modelling nodes HP and HT).

During the Operations phase, selenium concentrations in the water are predicted to be greater than the BC WQG (0.002 mg/L or 2 µg/L) by up to 3.0 fold at the HP modelling node. During the time in which Harlequin Duck could be present in Harper Creek, selenium is predicted to be greater than the BC WQG only during August in Years 18 to 23 (Operations 1 phase) and Years 26 to 28 (Operations 2 phase). Selenium is predicted to be below BC WQGs in all months and years after January of Year 29. Therefore, the effect of habitat alteration due to contaminants may occur during the Operations phase in August for nine years, if Harlequin Ducks visit the LSA (see Appendix 16-B for complete details).

Based on the expected case water quality model results (Appendix 13-C), the maximum predicted concentration is 5.9 µg/L during the Closure phase at the HT modelling node. Based on the unrecovered seepage sensitivity case (Appendix 13-C), the maximum predicted concentration of selenium in Harper Creek is 6.0 µg/L at the HP modelling node during the Operations 2 phase. The predicted concentrations are lower than the toxicity threshold for birds of 11.5 µg/L, and below the environmental target concentration proposed for Harper Creek (10 µg/L; Selenium Management Plan, Section 24.12 and Appendix 16-B). Despite mitigation, there is potential for a residual effect of habitat alteration due to contaminants, if Harlequin Ducks occur in the LSA. At this stage, none have been recorded in the LSA and this assessment is included as a conservative measure.

Characterization and Likelihood of Harlequin Duck Habitat Alteration due to Contaminants

Habitat alteration due to contaminants is predicted to result in a residual effect for Harlequin Ducks due to selenium levels above BC WQGs (but below toxicity thresholds for birds) at two modelling locations in Harper Creek. Table 16.6-15 characterizes the residual effect of habitat alteration due to contaminants on harlequin duck.

The likelihood that toxicological effects will occur in Harlequin Duck due to Project-related elevation in Se concentration in the aquatic environment is low. This is because the concentration of Se is predicted to increase in the lotic environments of Harper Creek but is expected to remain below toxicity thresholds for birds. In other words, although the concentration of Se in water is predicted to be greater than guidelines for wildlife, it is unlikely that birds will be experience adverse effects due to Se exposure. Monitoring will be carried out under the Fish and Aquatic Effects Monitoring and Management Plan (Section 24.6) and the Selenium Management Plan (Section 24.12) to ensure that potential effects in the aquatic environment are identified and adaptively managed as needed.

Table 16.6-15. Residual Effects of the Project on Harlequin Duck

Criterion	Characterization	Explanation
Magnitude	Medium	The residual effect is considered to have a medium magnitude because although the predicted concentrations are above BC WQG (0.002 mg/L or 2 µg/L), they remain lower than the toxicity threshold for birds of 11.5 µg/L, and below the environmental target concentration proposed for Harper Creek (10 µg/L).
Geographic Extent	Regional	The concentration of Se is predicted to occur along Harper Creek in the RSA.
Frequency	Regular	The frequency of the residual effect is considered regular because exposure varies depending on phase, and because Harlequin Duck use of upper Harper Creek has not been demonstrated. During the Operations phase, selenium will be above guidelines during one month of the year (August) over approximately nine years. During Closure and Post-Closure, selenium levels will be above guidelines during the breeding season beginning in Year 31 and lasting through Post-Closure.
Duration	Future	The duration of the residual effect will generally last into the Post-Closure phase and beyond.
Reversibility	Partially Reversible	It is anticipated that the effect can be partially reversible when selenium levels are below guidelines (i.e., Post-Closure or beyond).
Resiliency	Neutral	Resiliency of the Harlequin Duck to the potential for adverse effects due to selenium was assessed as neutral. The levels of selenium are expected to remain below toxicity thresholds for birds.

16.6.5 Olive-sided Flycatcher

16.6.5.1 Risk Ratings for Potential Effects

Olive-sided Flycatchers were assessed for potential Project-related effects. Habitat alteration and loss, disturbance and displacement, and mortality were considered for the effects assessment (Table 16.6-16); however, only disturbance and displacement is considered residual after mitigation (Section 16.6.5.3 to 16.6.5.5 provides further information).

Table 16.6-16. Risk Ratings of Project Effects on Olive-sided Flycatcher

Potential Effect Category	Potential Effects Considered	Phase in which Potential Effects may Occur		
		Construction	Operations	Closure and Post-Closure
Habitat Alteration and Loss	Habitat Loss	●	●	
Disturbance and Displacement	Noise Disturbance	●	●	
Mortality	Vegetation Clearing and/or Building Demolition	●	●	
	Wildlife-Vehicle Collisions			

(continued)

Table 16.6-16. Risk Ratings of Project Effects on Olive-sided Flycatcher (completed)

Potential Effect Category	Potential Effects Considered	Phase in which Potential Effects may Occur		
		Construction	Operations	Closure and Post-Closure
Mortality *(cont'd)*	Power Line			
	Nuisance Animals			

Notes:
blank = No interaction expected; no monitoring required, no further consideration warranted.
● *= Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; if minor, may require monitoring; may warrant further consideration.*
● *= Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*
● *= Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

16.6.5.2 Residual Effects

Table 16.6-17 provides a summary of mitigation measures for Olive-sided Flycatchers, effectiveness of mitigation, and whether there is a residual effect after mitigation. The three potential residual effects are described below in the following sections.

Table 16.6-17. Proposed Mitigation Measures and their Effectiveness for Olive-sided Flycatcher

Olive-sided Flycatcher			
Potential Effects	Proposed Mitigation Measure	Effectiveness *(Low, Moderate, High, Unknown)*	Potential Residual Effect *(Y/N)*
Habitat Alteration and Loss	Creation of edge habitat	Moderate	N
Disturbance and Displacement	Noise management plan	Low	Y
Mortality	Active nests will not be destroyed during vegetation clearing activities.	High	N

16.6.5.3 Olive-sided Flycatcher Habitat Alteration and Loss

Olive-sided Flycatchers preferentially use coniferous forest edges for breeding habitat. A total of 3,126 ha of suitable habitat (habitat ranking high (H) and moderate (M)) was identified in the LSA during baseline habitat suitability modelling. This habitat is distributed throughout the study area at all elevations (see Appendix 15-A).

Of the 3,126 ha of suitable habitat in the LSA, 728.8 (23.3%) will be lost during Construction, and an additional 4.2 ha (1.4%) will be lost during Operations (Table 16.6-18). however, additional edge habitat will be created as a result of vegetation clearing and Project construction. It is not possible to calculate the amount of edge habitat that will be created, but using professional judgement, it is assumed that the amount of habitat loss will be mitigated by the amount of new edge habitat

created. Furthermore, this habitat is considered common in the regional area; therefore, it is expected that additional habitat exists outside of the LSA. Although 23% of available habitat may be lost, the creation of edge habitat and assumed availability of habitat outside of the LSA will mitigate the effect of habitat loss on Olive-sided Flycatcher. With mitigation and using professional judgement, no residual effect of habitat loss is anticipated for Olive-sided Flycatchers.

Table 16.6-18. Olive-sided Flycatcher Habitat Loss due to the Project Footprint

VC	Total Suitable Habitat in LSA (ha)	Project Phase	Total Suitable Habitat Lost in LSA(ha)	Total Suitable Habitat Lost in LSA (%)
Olive-sided Flycatcher	3,126	Construction	728.8	23.3
		Operations	45.2	1.4

16.6.5.4 Olive-sided Flycatcher Disturbance and Displacement

Songbirds can be affected by elevated continuous noise levels that prevent effective auditory communication. In areas where noise levels are above 47 dBA, songbird density has been shown to decrease (Rien Reijnen, Foppen, and Meeuwsen 1996). Ash-throated Flycatchers have been known to alter their pitch of vocalization – increasing it with increasing background noises (Clinton D. Francis, Ortega, and Cruz 2011). Grey Flycatcher occupancy declines in continuously noisy areas, and the birds either are not present or do not vocalize when noise levels are as high as 62.6 dB (Clinton D. Francis, Ortega, and Cruz 2011). Grey Flycatchers have also been found to avoid noisy areas when nesting (C. D. Francis, Ortega, and Cruz 2009). Therefore, the effect of noise on Olive-sided Flycatchers was assessed due to the evidence that other flycatcher species respond to noise disturbance.

Noise contour maps and habitat suitability mapping were used to determine the amount of Olive-sided Flycatchers habitat that may be disturbed. Continuous Project noise was assessed for Olive-sided Flycatchers. Instantaneous blasting noise was not considered, due to the short duration of blasting activities (e.g., one blasting event per day). The 45 dBA (for Operations phase) and 55 dBA (for Construction phase) noise levels were selected based on chronic noise threshold values identified for birds (see Section 16.5.1.3).

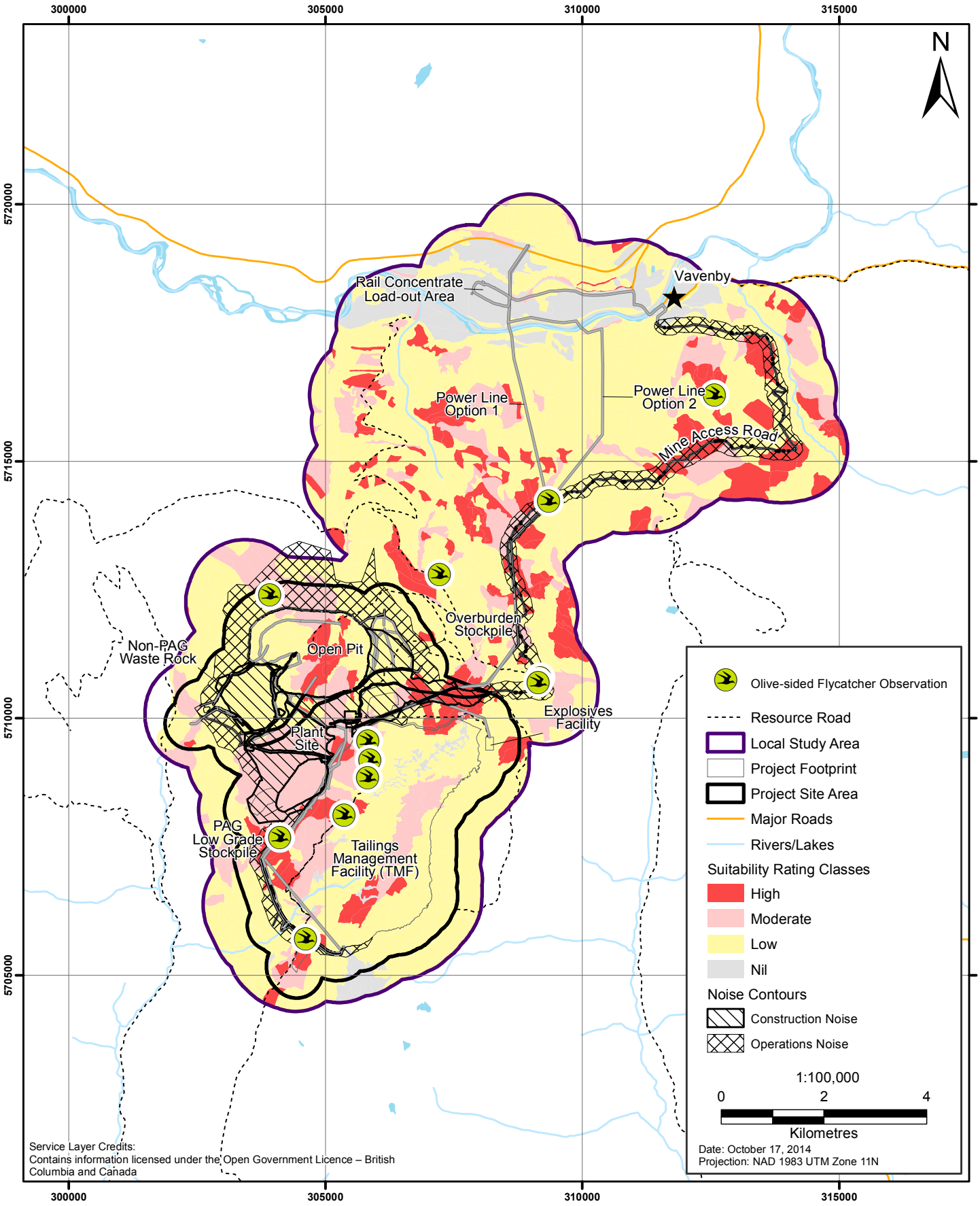
During the Construction phase, 253.4 ha (8.1% of habitat in LSA) of Olive-sided Flycatchers habitat may experience continuous noise levels above the 55 dBA threshold (Table 16.6-19; Figure 16.6-1). During the Operations phase, 328.6 ha (10.5% of habitat in the LSA) may experience continuous noise levels above the 45 dBA threshold.

Table 16.6-19. Olive-sided Flycatcher Habitat Potentially Disturbed due to Continuous Project Noise during Construction and Operations

VC	Total Suitable Habitat in LSA (ha)	Project Phase	Breeding Habitat Disturbed (ha)	Breeding Habitat Disturbed (%)
Olive-sided Flycatcher	3,126.1	Construction (55 dBA)	253.4	8.1%
		Operations (45 dBA)	328.6	10.5%

Figure 16.6-1

Olive-sided Flycatcher Habitat Potentially Disturbed due to Continuous Project Noise during Construction and Operation



As a result of Project construction, edge habitat (i.e., suitable Olive-sided Flycatcher habitat) will be created and may be used by Olive-sided Flycatchers. This habitat would be near Project activities and within the noise contours presented in Figure 16.6-1. Although habitat will likely be created, this may be in areas experiencing continuous noise above acceptable thresholds for Olive-sided Flycatchers. Therefore, a residual effect of disturbance due to noise is predicted for Olive-sided Flycatchers.

Characterization and Likelihood of Olive-sided Flycatcher Disturbance and Displacement

Disturbance and displacement is predicted to result in a residual effect for Olive-sided Flycatchers due to noise in suitable habitat and newly created edge habitat after construction activities. Table 16.6-20 characterizes the residual effect of disturbance and displacement on Olive-sided Flycatchers.

Table 16.6-20. Characterization of Residual Effect of Disturbance and Displacement on Olive-sided Flycatcher

Criterion	Characterization	Explanation
Magnitude	Low	8% (Construction phase) and 10% (Operations phase) of Olive-sided Flycatchers breeding habitat may experience noise levels great enough to cause displacement.
Geographic Extent	Local	Noise levels above threshold levels will remain within the LSA.
Frequency	Continuous	Continuous Project noise will be constant throughout Construction and Operations.
Duration	Medium-term	Effects to suitable habitat will last to the end of Operations.
Reversibility	Reversible	The effects to Olive-sided Flycatcher are expected to be reversible when Project activities cease.
Resiliency	Neutral	Olive-sided Flycatchers may be able to respond and adapt to the effect.

The probability of disturbance and displacement occurring is considered low (effect has <40% chance of effect occurring; Table 16.6-2), as the use of the newly created edge habitat is unknown, and the response of flycatchers to noise (e.g., habituation or displacement) is uncertain.

16.6.5.5 Olive-sided Flycatcher Mortality

The potential for Olive-sided Flycatchers mortality is considered low. Mitigation measures will include pre-clearing surveys for nests if clearing activities are scheduled to occur in Olive-sided Flycatchers habitat between May and August. With mitigation, no residual effect of mortality on flycatchers is anticipated.

16.6.6 Bald Eagle

16.6.6.1 Risk Ratings for Potential Effects

Bald Eagles were assessed for potential Project-related effects (Table 16.6-21). Habitat loss is not anticipated to affect bald eagles; of the 769.3 ha of suitable habitat modelled in the LSA, 6.3 ha (0.8%

of habitat in the LSA) may be lost due to the footprint. This is negligible, and is not discussed further in the effects assessment. Due to the limited amount of habitat in the LSA or Project Site, disturbance and displacement is not considered a potential effect on eagles. Mortality is not predicted to result in residual effects after mitigation and is described in Section 16.6.6.3.

Table 16.6-21. Risk Ratings of Project Effects on Bald Eagles

Potential Effect Category	Potential Effects Considered	Phase in which Potential Effects may Occur		
		Construction	Operations	Closure and Post-Closure
Habitat Alteration and Loss	Habitat Loss			
Disturbance and Displacement	Noise Disturbance			
Mortality	Vegetation Clearing and/or Building Demolition	●	●	
	Wildlife-Vehicle Collisions			
	Power Line		●	●
	Nuisance Animals			

Notes:
blank = No interaction expected; no monitoring required, no further consideration warranted.
● *= Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; if minor, may require monitoring; may warrant further consideration.*
● *= Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*
● *= Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

16.6.6.2 Residual Effects

Table 16.6-22 provides a summary of mitigation measures for Bald Eagles, effectiveness of mitigation, and whether there is a residual effect after mitigation. The potential residual effect of mortality is described below in the following section.

Table 16.6-22. Proposed Mitigation Measures and their Effectiveness for Bald Eagle

Bald Eagle			
Potential Effects	Proposed Mitigation Measure	Effectiveness *(Low, Moderate, High, Unknown)*	Potential Residual Effect *(Y/N)*
Habitat Alteration and Loss	N/A	N/A	N
Disturbance and Displacement	N/A	N/A	N
Mortality	Nests will not be destroyed during construction activities; power line will be designed to reduce effects.	High	N

16.6.6.3 Bald Eagle Mortality

The effect of mortality due to vegetation clearing and the power line is expected to be negligible after mitigation. For example, nests will not be destroyed during vegetation clearing. To minimize effects due to the power line, the mitigation measures described in Section 16.5.2.3 will be implemented to minimize potential effects on raptors due to electrocution, including measures such as maintaining minimum horizontal and vertical clearances between energized and grounded components. With mitigation, no residual effect of mortality is anticipated for bald eagles.

16.6.7 Northern Goshawk

16.6.7.1 Risk Ratings for Potential Effects

Northern Goshawks were assessed for potential Project-related effects (Table 16.6-23). Habitat loss is not anticipated to affect Northern Goshawk; of the 3,271 ha of suitable habitat modelled in the LSA, 24.5 ha (0.7% of habitat in the LSA) may be lost due to the footprint. This is negligible, and is not discussed further in the effects assessment. Disturbance and displacement and mortality are not predicted to result in residual effects after mitigation. Details are provided in the following sections (16.6.7.3 and 16.6.7.4).

Table 16.6-23. Risk Ratings of Project Effects on Northern Goshawks

Potential Effect Category	Potential Effects Considered	Phase in which Potential Effects may Occur		
		Construction	Operations	Closure and Post-Closure
Habitat Alteration and Loss	Habitat Loss			
Disturbance and Displacement	Noise Disturbance	●	●	
Mortality	Vegetation Clearing and/or Building Demolition	●	●	
	Wildlife-Vehicle Collisions			
	Power Line		●	●
	Nuisance Animals			

Notes:
blank = No interaction expected; no monitoring required, no further consideration warranted.
● *= Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; if minor, may require monitoring; may warrant further consideration.*
● *= Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*
● *= Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

16.6.7.2 Residual Effects

Table 16.6-24 provides a summary of mitigation measures for Northern Goshawk, effectiveness of mitigation, and whether there is a residual effect after mitigation. The potential residual effects are described below in the following sections.

Table 16.6-24. Proposed Mitigation Measures and their Effectiveness for Northern Goshawk

Northern Goshawk			
Potential Effects	**Proposed Mitigation Measure**	**Effectiveness** *(Low, Moderate, High, Unknown)*	**Potential Residual Effect** *(Y/N)*
Habitat Alteration and Loss	N/A	N/A	N
Disturbance and Displacement	Noise management plan	Moderate	N
Mortality	Nests will not be destroyed during construction activities; power line will be designed to reduce effects.	High	N

16.6.7.3 Northern Goshawk Disturbance and Displacement

Several studies have determined that raptor species are able to habituate to chronic noise disturbances (Haugh 1982a; C. M. White and T. Thurow 1985) and are not affected by infrequent noise from heavy truck traffic (Grubb, Pater, and Delaney 1998). Blasting may cause some disturbance, but does not appear to lower productivity (DeLong and Steenhof 2004a).

Noise contour maps and habitat suitability mapping were used to determine the amount of northern goshawk habitat that may be disturbed. Continuous Project noise and instantaneous blasting noise were assessed for goshawks. The 45 dBA (for Operations phase) and 55 dBA (for Construction phase) noise levels were selected based on chronic noise threshold values identified for birds (see Section 16.5.1.3), and 108 dB Lpeak was selected as a conservative estimate for blasting noise which is approximate to the sound of an auto horn at approximately 1 m. Furthermore, this is an instantaneous noise source, as blasting will occur once per day, lasting a few seconds.

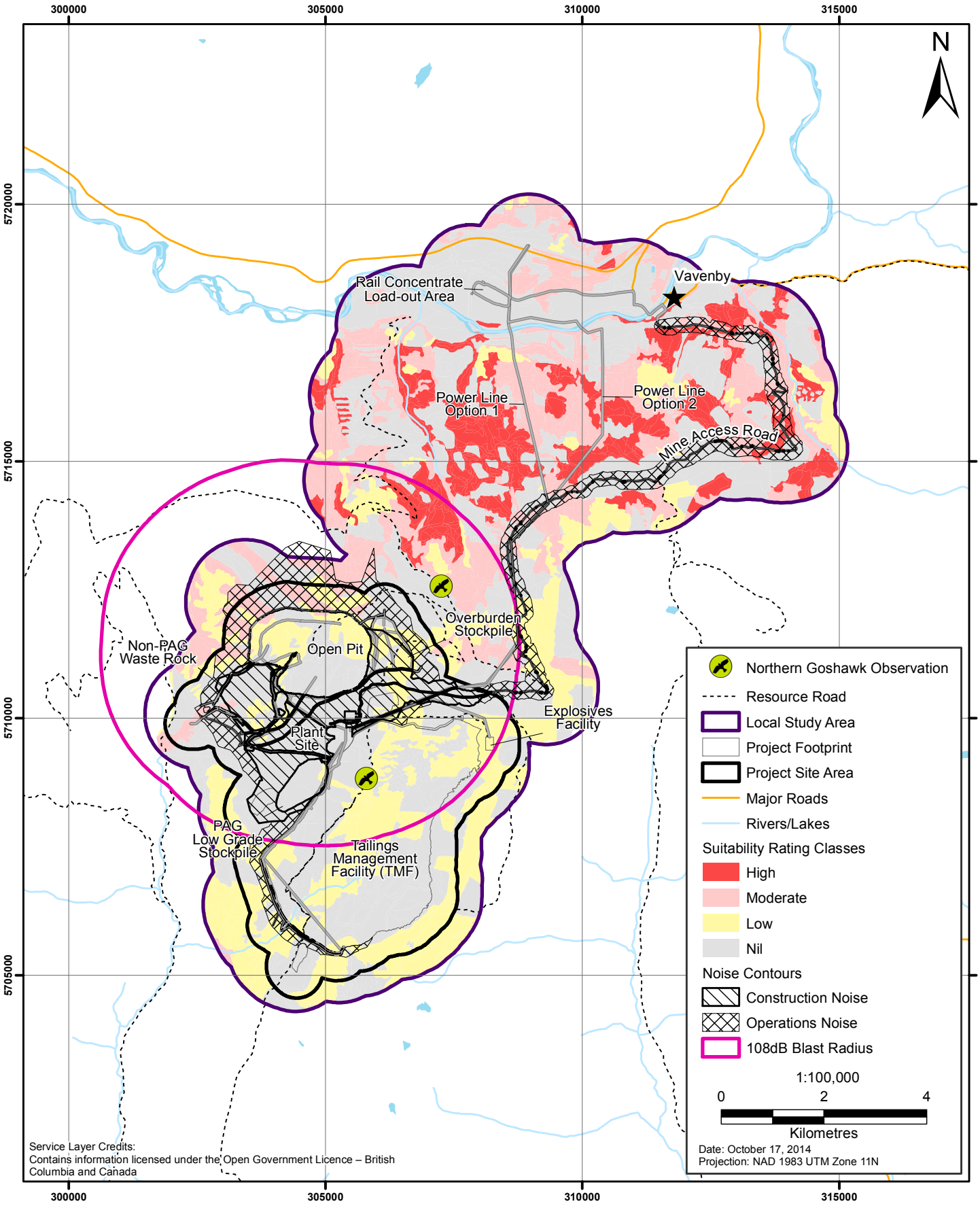
During the Construction phase, 3.1 ha (0.1% of habitat in LSA) of northern goshawk habitat may experience continuous noise levels above the 55 dBA threshold (Table 16.6-25; Figure 16.6-2). During the Operations phase, 311.9 ha (9.5% of habitat in the LSA) may experience continuous noise levels above the 45 dBA threshold. During instantaneous blasting events (i.e., once per day), 640 ha (19.6% of habitat in the LSA) may experience brief and temporary noise levels above 108 dB Lpeak. However, although breeding habitat was modelled, no northern goshawk nests were observed during baseline studies within the area potentially exposed to noise.

Table 16.6-25. Northern Goshawk Habitat Potentially Disturbed due to Noise during Construction and Operations

VC	Total Suitable Habitat in LSA (ha)	Project Phase	Suitable Habitat Disturbed (ha)	Suitable Habitat Disturbed (%)
Northern Goshawk	3,271.0	Construction (55 dBA)	3.1	0.1%
		Operations (45 dBA)	311.9	9.5%
		Blasting (108 dB Lpeak)	640.0	19.6%

Figure 16.6-2

Northern Goshawk Habitat Potentially Disturbed due to Noise during Construction, Operation, and Blasting



Raptor species appear able to habituate to disturbances. Peregrine falcons are able to nest successfully within a few hundred metres of areas with blasting, construction, quarrying, aircraft activity, and mining operations (Pruett-Jones, White, and Devine 1980; Haugh 1982; White and Thurow 1985; White, Emison, and Bren 1988). Other research on falcons suggest that falcons exposed to blasting do not suffer lower productivity (DeLong and Steenhof 2004b). Because no nests were observed in the area potentially exposed to noise and because raptors can habituate to noise, no residual effect of disturbance is anticipated for northern goshawks.

16.6.7.4 Northern Goshawk Mortality

The effect of mortality due to vegetation clearing and the power line is expected to be negligible after mitigation. For example, nests will not be destroyed during vegetation clearing. To minimize effects due to the power line, the mitigation measures described in Section 16.5.2.3 will be implement to minimize potential effects on raptors due to electrocution, including measure such as maintaining minimum horizontal and vertical clearances between energized and grounded components. With mitigation, no residual effect of mortality is anticipated for Northern Goshawk.

16.6.8 Bats

16.6.8.1 Risk Ratings for Potential Effects

Bats were assessed for potential Project-related effects. Mortality was considered for the effects assessment; however, the effect is not considered residual after mitigation (Section 16.6.8.3 provides further information). The effect of habitat alteration and loss, and disturbance and displacement were scoped out of the bat assessment because they are determined to have no interaction with bats. Bats were primarily observed at low elevations during baseline surveys, outside of the Project Site where the majority of habitat loss and disturbance will occur. Therefore, no interaction is anticipated for these two effects.

The potential residual effects considered in the assessment for bats are summarized in Table 16.6-26, and described in Section 16.6.8.3.

16.6.8.2 Residual Effects

Table 16.6-27 provides a summary of mitigation measures for bats, effectiveness of mitigation, and whether there is a predicted residual effect after mitigation. The potential residual effect of mortality is described below in the following section.

16.6.8.3 Bat Mortality

The potential source of bat mortality in association with the Project will be mortality resulting from demolition of buildings during Construction, Operations, or Closure if these activities were to occur while bats are present. However, buildings will not be demolished or modified if bats are actively roosting in the structures. Therefore, with mitigation, no residual effect of mortality on bats is anticipated.

Table 16.6-26. Risk Ratings of Project Effects on Bats

Potential Effect Category	Potential Effects Considered	Phase in which Potential Effects may Occur		
		Construction	Operations	Closure and Post-Closure
Habitat Alteration and Loss	Habitat Loss			
Disturbance and Displacement	Noise Disturbance			
Mortality	Vegetation Clearing and/or Building Demolition	●	●	
	Wildlife-Vehicle Collisions			
	Power Line			
	Nuisance Animals			

Notes:
blank = No interaction expected; no monitoring required, no further consideration warranted.
● *= Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; if minor, may require monitoring; may warrant further consideration.*
● *= Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*
● *= Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

Table 16.6-27. Proposed Mitigation Measures and their Effectiveness for Bats

Bats			
Potential Effects	Proposed Mitigation Measure	Effectiveness *(Low, Moderate, High, Unknown)*	Potential Residual Effect *(Y/N)*
Habitat Alteration and Loss	N/A	N/A	N
Disturbance and Displacement	N/A	N/A	N
Mortality	Modifications or demolition of buildings will not occur when bats are using the structures.	High	N

16.6.9 Furbearers (Fisher and Wolverine)

16.6.9.1 Risk Ratings for Potential Effects

Furbearers were assessed for potential Project-related effects (Table 16.6-28). Mortality was considered for the effects assessment; however, this effect is not considered residual after mitigation (Section 16.6.9.3 provides further information). The effect of habitat alteration and loss, and disturbance and displacement were scoped out of the furbearer assessment because they are determined to have no interaction with furbearers.

Table 16.6-28. Risk Ratings of Project Effects on Furbearers (Fisher and Wolverine)

Potential Effect Category	Potential Effects Considered	Phase in which Potential Effects may Occur		
		Construction	Operations	Closure and Post-Closure
Habitat Alteration and Loss	Habitat Loss			
Disturbance and Displacement	Noise Disturbance			
Mortality	Vegetation Clearing and/or Building Demolition			
	Wildlife-Vehicle Collisions	●	●	
	Power Line			
	Nuisance Animals	●	●	

Notes:
blank = No interaction expected; no monitoring required, no further consideration warranted.
● *= Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; if minor, may require monitoring; may warrant further consideration.*
● *= Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*
● *= Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

Habitat alteration and loss is not considered a potential effect for fisher and wolverine. Given the high level of forest fragmentation that already exists in the LSA, use of the area by fishers is low (Appendix 15-A). Fishers live in forested habitats, mostly at low- to mid-elevations. The majority of Project effects are expected to occur at higher elevations in less suitable habitat; therefore, habitat alteration and loss is not expected for fisher. Because of the lack of suitable denning habitat in the LSA, and the wide-ranging nature of the wolverine (Section 16.4.3.10; Appendix 15-A), habitat alteration and loss is not expected for wolverine.

Disturbance and displacement is not considered a potential effect for furbearers. Wolverine are most sensitive to noise during the denning period, sometimes resulting in females and their litters relocating or abandoning dens (Magoun and Copeland 1998b; Heinemeyer, Aber, and Doak 2001). However, no suitable denning habitat was identified in the LSA (Section 16.4.3.10; Appendix 15-A). Similarly, fisher habitat was not observed near the Project Site (Section 16.4.3.9; Appendix 15-A). Therefore, the effect of disturbance and displacement on furbearers (fisher and wolverine) is not considered further in the assessment.

16.6.9.2 Residual Effects

Table 16.6-29 provides a summary of mitigation measures for furbearers, effectiveness of mitigation, and whether there is a predicted residual effect after mitigation. The potential residual effect of mortality is described below in the following sections.

16.6.9.3 Furbearer Mortality

The potential sources of mortality for both fisher and wolverine include wildlife-vehicle collisions and potential destruction of nuisance animals if they become habituated.

Table 16.6-29. Proposed Mitigation Measures and their Effectiveness for Furbearers (Fisher and Wolverine)

Wolverine			
Potential Effects	**Proposed Mitigation Measure**	**Effectiveness** *(Low, Moderate, High, Unknown)*	**Potential Residual Effect** *(Y/N)*
Habitat Alteration and Loss	N/A	N/A	N
Disturbance and Displacement	N/A	N/A	N
Mortality	Traffic and road mitigation; management of wastes and other attractants on site.	High	N

Vehicle Collisions

Vehicle–wildlife collisions are cited as a cause of direct mortality for a variety of wildlife species (Vieira 1996; Kerley et al. 2002; Deem and Emmons 2005). However, wolverine and fisher often avoid roads and human activities (e.g., Carroll et al. 2001, Rowland et al. 2003, May et al. 2006, all as cited in (Copeland et al. 2007; John Krebs, Lofroth, and Parfitt 2007). To mitigate the effect of mortality due to vehicles, truck speed limits will be developed for the access road and wildlife on or near the road corridor may be given the right-of-way to safely cross and exit the road corridor to lessen the probability of vehicle strikes as described in the Traffic and Access Management Plan (Section 24.16). Therefore, mortality due to vehicle strikes is not anticipated to result in a residual effect on wolverine or fisher following mitigation.

Nuisance Animals

Furbearers may be attracted to Project features by odours, shelter, food, and prey (Ruggiero et al. 1994). Wolverines, for example, can be curious and have been found to investigate and rob food from campsites, food caches, and empty cabins (COSEWIC 2003). Mortality to wolverine and fisher may result when wildlife attracted to Project infrastructure become human habituated and aggressive, and thus pose a threat to human safety. Nuisance animals can sometimes be re-located, but often if the problem persists, the animal is destroyed.

Mitigation measures will be implemented at all Project facilities in order to limit the attractiveness of the sites to furbearers using standard mitigation techniques described in the Waste Management Plan (Section 24.18). With adherence to mitigation, no residual effect of mortality due to nuisance animals is anticipated for wolverine or fisher.

16.6.10 Grizzly Bear

16.6.10.1 Risk Ratings for Potential Effects

Grizzly bears were assessed for potential Project-related effects (Table 16.6-30). Habitat alteration and loss, and mortality were considered for the effects assessment. Mortality was not considered

residual after mitigation (Sections 16.6.10.4 provides further information). The effect of disturbance and displacement was scoped out of the grizzly bear assessment because the area has already been disturbed by previous human development and habitat fragmentation, resulting in pre-existing reduced habitat effectiveness and consequently reduced use of the area by grizzly bears (Section 16.4.3.11; Appendix 15-A; (Simpc'w First Nation 2012).

Table 16.6-30. Risk Ratings of Project Effects on Grizzly Bears

Potential Effect Category	Potential Effects Considered	Phase in which Potential Effects may Occur		
		Construction	Operations	Closure and Post-Closure
Habitat Alteration and Loss	Habitat Loss	●	●	
Disturbance and Displacement	Noise Disturbance			
Mortality	Vegetation Clearing and/or Building Demolition			
	Wildlife-Vehicle Collisions	●	●	
	Power Line			
	Nuisance Animals	●	●	

Notes:
blank = No interaction expected; no monitoring required, no further consideration warranted.
● *= Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; if minor, may require monitoring; may warrant further consideration.*
● *= Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*
● *= Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

16.6.10.2 Residual Effects

Table 16.6-31 provides a summary of mitigation measures for grizzly bears, effectiveness of mitigation, and whether there is a predicted residual effect after mitigation. The potential residual effects are described below in the following sections.

16.6.10.3 Grizzly Bear Habitat Loss

This assessment evaluates the effects of habitat loss and alteration on grizzly bears. Habitat loss will occur in areas where Project infrastructure overlaps high-quality grizzly bear habitat. To evaluate the potential effects of the proposed Project on grizzly bear habitat, the LSA was mapped using habitat suitability models for spring, summer, and fall. The habitat suitability model used a 6-class ranking system; habitat ranked as High (H) or Moderately High (MH) and Moderate (M) were considered the most suitable habitat and therefore included in the calculations of lost habitat.

Table 16.6-31. Proposed Mitigation Measures and their Effectiveness for Grizzly Bear

Grizzly Bear			
Potential Effects	**Proposed Mitigation Measure**	**Effectiveness** *(Low, Moderate, High, Unknown)*	**Potential Residual Effect** *(Y/N)*
Habitat Alteration and Loss	Reclamation of habitat.	Moderate	Y
Disturbance and Displacement	N/A	N/A	N
Mortality	Traffic and road mitigation; management of wastes and other attractants on site (Waste Management Plan).	High	N

The history of disturbance and the high road density (greater than 2.4 km/km^2) already existing in the LSA has likely reduced the habitat effectiveness in the area, as shown by the minimal use of the LSA by grizzly bears during baseline surveys (Section 16.4.3.11; Appendix 15-A), as well as by First Nations (Simpcw First Nation 2012). It is recognized that the area currently supports a very low density of bears due to high road density, past and current forestry activity. Although no dens were found in the LSA, a few bear tracks were observed in the study area.. Habitat mapping of grizzly bear feeding habitat was used to establish the extent of habitat loss. During Project Construction 2.6%, 19.8%, and 29.6% of spring, summer, and fall feeding habitat, respectively, is expected to be lost (Table 16.6-32). The greatest loss of habitat is within the TMF and open pit footprint. Expansion of Project footprints and other activities during Operations will further reduce summer and fall feeding habitat by 1.1% and 3.5% respectively (Table 16.6-32). Therefore, a residual effect of habitat loss on grizzly bears is predicted.

Characterization and Likelihood of Grizzly Bear Habitat Alteration and Loss

Habitat alteration and loss is predicted to result in a residual effect for grizzly bears due to the loss of summer and fall feeding habitat in the LSA. Table 16.6-33 characterizes the residual effect of habitat alteration and loss on grizzly bears.

The probability of habitat loss occurring is considered Low (effect has <40% chance of effect occurring; Table 16.6-2). Grizzly bears do not currently use the LSA; therefore, the suitability of habitat that was modelled (and therefore the amount lost) may not be representative of actual loss of habitat.

Characterization and Likelihood of Grizzly Bear Habitat Alteration and Loss

Habitat alteration and loss is predicted to result in a residual effect for grizzly bears due to the loss of summer and fall feeding habitat in the LSA. Table 16.6-33 characterizes the residual effect of habitat alteration and loss on grizzly bears.

Table 16.6-32. Grizzly Bear Habitat Loss due to the Project Footprint

VC	Total Suitable Habitat in LSA (ha)	Project Phase	Total Suitable Habitat Lost in LSA(ha)	Total Suitable Habitat Lost in LSA (%)
Grizzly Bear – Spring Feeding	120.1	Construction	3.1	2.6
		Operations	0	0
Grizzly Bear – Summer Feeding	2,230.0	Construction	442.6	19.8
		Operations	25.0	1.1
Grizzly Bear – Fall Feeding	4,393.6	Construction	1,299.1	29.6
		Operations	154.8	3.5

Table 16.6-33. Characterization of Residual Effect of Habitat Loss on Grizzly Bear

Criterion	Characterization	Explanation
Magnitude	Moderate	Approximately 20% of potential summer feeding habitat and 29.6% of potential fall feeding habitat may be removed; however, it is currently rarely used by grizzly bears.
Geographic Extent	Discrete	Effect of habitat loss is limited to the Project Site.
Frequency	Sporadic	Habitat alteration will occur sporadically. The majority of habitat will be lost during construction, but some additional habitat will be lost during the Operations phase.
Duration	Future	Habitat will be lost for more than 37 years (i.e., into Post-Closure phase and potentially beyond).
Reversibility	Partially Reversible	Effects to grizzly bear habitat are partially reversible with reclamation of some areas.
Resiliency	High	The area has been heavily disturbed by previous human development and activities, as a result grizzly bears are not currently using the area; therefore, the grizzly bear population can likely respond and adapt to the effect.

The probability of habitat loss occurring is considered Low (effect has <40% chance of effect occurring; Table 16.6-2). Grizzly bears do not currently use the LSA; therefore, the suitability of habitat that was modelled (and therefore the amount lost) may not be representative of actual loss of habitat.

16.6.10.4 Grizzly Bear Mortality

The potential sources of mortality for grizzly bears include wildlife-vehicle collisions and potential destruction of nuisance animals if they become habituated.

Vehicle Collisions

Vehicle–wildlife collisions are cited as a cause of direct mortality for a variety of wildlife species (Vieira 1996; Kerley et al. 2002; Deem and Emmons 2005). However, when traffic volume rises above a threshold point (over 10 VPH for grizzly bears; Waller and Servheen 2005), bears may avoid a

particular road, reducing the risk of mortality. To mitigate the effect of grizzly bear mortality due to vehicles, truck speed limits will be developed for the access road and wildlife on or near the road corridor may be given the right-of-way to safely cross and exit the road corridor to lessen the probability of vehicle strikes. Therefore, mortality due to vehicle strikes is not anticipated to result in a residual effect on grizzly bears following mitigation.

Nuisance Animals

Grizzly bears are often attracted to odours from human activity, which could result in individual bears becoming habituated "problem bears" (McLellan 1990; Blood 2001, 2002; COSEWIC 2002b). Once a bear becomes habituated to either humans or food, the probability of a negative human-bear interaction increases (S. Herrero 1985; Peine 2001).

Research has shown that in areas where effective mitigation measures are implemented, grizzly bears are able to maintain a high survival rate near human developments (Ciarniello 1997; Davis, Wellwood, and Ciarniello 2002), and their survival rate returns to that of bears with no known history of conflict with humans (Haroldson, Schwartz, and White 2005). Section 24.18 (Waste Management Plan) and Section 24.19 (Wildlife Management Plan) outline mitigation measures to be implemented to reduce the attractiveness of Project infrastructure for bears and the potential consequent conflicts. This includes measures such as exclusion (e.g., covering/fencing), proper storage of attractants, and on-site employee education. The destruction of grizzly bears will be avoided unless no other recourse is possible (and will only be conducted with due authorization from the appropriate wildlife management authority). With adherence to mitigation, no residual effect of mortality due to nuisance animals is anticipated for grizzly bears.

16.6.11 Moose

16.6.11.1 Risk Ratings for Potential Effects

Moose were assessed for potential Project-related effects (Table 16.6-34). Habitat alteration and loss, and mortality were considered for the effects assessment. Mortality was not considered residual after mitigation (Sections 16.6.11.3 and 16.6.11.4 provide further information). The effect of disturbance and displacement was scoped out of the moose assessment.

Table 16.6-34. Risk Ratings of Project Effects on Moose

Potential Effect Category	Potential Effects Considered	Phase in which Potential Effects may Occur		
		Construction	Operations	Closure and Post-Closure
Habitat Alteration and Loss	Habitat Loss	●	●	
Disturbance and Displacement	Noise Disturbance			
Mortality	Vegetation Clearing and/or Building Demolition			

(continued)

Table 16.6-34. Risk Ratings of Project Effects on Moose (completed)

Potential Effect Category	Potential Effects Considered	Phase in which Potential Effects may Occur		
		Construction	Operations	Closure and Post-Closure
Mortality *(cont'd)*	Wildlife-Vehicle Collisions	●	●	
	Power Line			
	Nuisance Animals			

Notes:
blank = No interaction expected; no monitoring required, no further consideration warranted.
● *= Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; if minor, may require monitoring; may warrant further consideration.*
● *= Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*
● *= Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

It is possible that a few individual moose are disturbed during construction activities during the summer months when they are expected to use the Project Site (Section 16.4.3.12; Appendix 15-A); however, summer is not the critical season for moose and it is predicted that there is a large amount of suitable habitat available for moose in the region. Therefore, no interaction is expected for moose and disturbance and is not discussed further in the assessment.

16.6.11.2 Residual Effects

Table 16.6-35 provides a summary of mitigation measures for moose, effectiveness of mitigation, and whether there is a predicted residual effect after mitigation. The potential residual effects are described below in the following sections.

Table 16.6-35. Proposed Mitigation Measures and their Effectiveness for Moose

Moose			
Potential Effects	**Proposed Mitigation Measure**	**Effectiveness** *(Low, Moderate, High, Unknown)*	**Potential Residual Effect** (Y/N)
Habitat Alteration and Loss	Reclamation of wetlands.	Low	Y
Disturbance and Displacement	N/A	N/A	N
Mortality	Traffic and Access Management Plan; speed limits.	Moderate	N

16.6.11.3 Moose Habitat Alteration and Loss

Winter habitat is generally considered to limit the number of moose that can be supported by a land base. Metabolic demands increase in winter because of the effort required to move through deep snow packs and tolerate colder weather (Safford 2004), and this occurs during a season where forage

has a lower nutritional value. BC MOE has mapped critical moose winter range (CMWR) in the area, and was used in the assessment. According to CMWR analysis a total of 1,012.5 ha of CMWR is located within the LSA, all at low-elevation areas along the North Thompson River Valley (see Appendix 15-A for details of habitat modelling).

Habitat modelling of moose growing season feeding, security and thermal habitat was completed for the LSA, due to the high elevation and lack of critical winter habitat in the area. This was combined with provincial maps of CMWR to assess the effect of habitat loss on moose. The habitat suitability model used a 5-class ranking system; habitat ranked as High or Moderately High and Moderate were considered the most suitable habitat and therefore included in the calculations of lost habitat (See Appendix 15-A).

Approximately 1% of CMWR will be affected by the Project. Therefore, the loss of winter habitat is not considered further in the assessment. The largest amount of habitat loss due the Project will occur during the Construction phase (77% loss of feeding/growing season habitat); however, this habitat is primarily rated as Moderate quality, and is not considered the most suitable habitat in the LSA. This habitat loss is mainly due to TMF development, and the subsequent loss of wetlands. During construction 19.3% of the total security/thermal-growing season habitat will be lost, most of which is found in the TMF, and therefore already considered in the growing season loss (Table 16.6-36). Although the Project will not affect critical moose winter range (i.e., the limiting season for moose), moderately suitable growing season habitat will be affected; therefore, a residual effect of habitat loss is predicted for moose.

Table 16.6-36. Moose Habitat Loss due to the Project Footprint

VC	Total Suitable Habitat in LSA (ha)	Project Phase	Total Suitable Habitat lost in LSA(ha)	Total Suitable Habitat Lost in LSA (%)
Moose – Growing Season Feeding	72.6	Construction	55.9	77.0
		Operations	0.3	0.4
Moose – Security/ Thermal Cover	8,201.6	Construction	1584.4	19.3
		Operations	214.1	2.6

Characterization and Likelihood of Moose Habitat Alteration and Loss

Habitat alteration and loss is predicted to result in a residual effect for moose due to the loss of growing season feeding habitat in the LSA. Table 16.6-37 characterizes the residual effect of habitat alteration and loss on moose.

The probability of habitat loss occurring is considered Moderate (effect has 40 - 80% chance of effect occurring; Table 16.6-2). Habitat loss will occur; however, the habitat that overlaps with the Project Site is primarily considered "Moderate" quality and use of that habitat has not been confirmed.

Table 16.6-37. Characterization of Residual Effect of Habitat Loss on Moose

Criterion	Characterization	Explanation
Magnitude	Low	Approximately 1% of critical moose winter range will be affected by the Project. Approximately 77% of potential (moderate quality) growing season habitat in the LSA may be lost; however, this is not a limiting season for moose, and there is no evidence of use of this habitat by moose.
Geographic Extent	Discrete	Effect of habitat loss is limited to the Project Site.
Frequency	Sporadic	Habitat alteration will occur sporadically. The majority of habitat will be lost during construction, but some additional habitat will be lost during the Operations phase.
Duration	Future	Habitat will be lost for more than 37 years (i.e., into Post-Closure phase and potentially beyond).
Reversibility	Partially Reversible	Effects to moose habitat are partially reversible with reclamation of some areas.
Resiliency	High	The area has been heavily disturbed by previous human development and moose can likely respond and adapt to the effect.

16.6.11.4 Moose Mortality

The potential source of mortality for moose is wildlife-vehicle collisions in areas where roads used by the Project overlap high-quality moose habitat. Direct mortality of moose caused by vehicle collisions may occur during the proposed Project Construction, Operations, and Closure phases.

Vehicle Collisions

During the growing season (spring, summer, and fall), moose may frequent forest edge habitats, such as road verges, because they contain high-quality forage and provide easy movement. During the winter, access roads will require snow removal. Moose may preferentially use ploughed roads when the winter snowpack is deep. High snowbanks of 60 cm or more (Peek et al. 1982) can trap moose on access roads, putting them at greater risk of vehicle strikes. Moose have been observed near the existing access roads in the winter. During baseline surveys, moose tracks were observed in the winter along Harper Creek FSR and near Saskum Lake FSR (Section 16.4.3.12; Appendix 15-A). Implementation of the Traffic and Access Management Plan (Section 24.16) and mitigation such as adherence to speed limits and signage, will mitigate this effect. With mitigation, no residual effect of mortality on moose is anticipated.

16.6.12 Mountain Caribou

16.6.12.1 Risk Ratings for Potential Effects

Mountain caribou were assessed for potential Project-related effects (Table 16.6-38). All three potential effects were scoped out of the assessment for caribou. Caribou were considered a VC because they are a species of interest; however, because they are known to be absent from the LSA (Section 16.4.3.13; Appendix 15-A), no effects are expected to interact with mountain caribou.

Table 16.6-38. Risk Ratings of Project Effects on Mountain Caribou

Potential Effect Category	Potential Effects Considered	Phase in which Potential Effects may Occur		
		Construction	Operations	Closure and Post-Closure
Habitat Alteration and Loss	Habitat Loss			
Disturbance and Displacement	Noise Disturbance			
Mortality	Vegetation Clearing and/or Building Demolition			
	Wildlife-Vehicle Collisions			
	Power Line			
	Nuisance Animals			

Notes:
blank = No interaction expected; no monitoring required, no further consideration warranted.
● *= Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; if minor, may require monitoring; may warrant further consideration.*
● *= Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*
● *= Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

Information from aerial surveys and telemetry studies of mountain caribou in southern BC were compiled to document the distribution of herds up to 1994 (Simpson 1994). The Wells Gray South herd occupied areas south of the Thompson River between Adams Lake and the Dunn Peak Protected area. Caribou numbers were declining and occupied ranges were shrinking in many parts of the mountain caribou's range especially south of Wells Gray Park. Movement of animals between the Wells Gray South herd and the Revelstoke Herd to the east have also been documented (Simpson 1994). The Kamloops LRMP (1995) planning table established special management zones primarily to address forest practices within mountain caribou ranges in the region. The area between Dunn Peak and Adam's lake (included the LSA) was not included in the special management zones, likely due to the high availability of access, high road density, forest development and habitat fragmentation. The 2002 Provincial strategy classified this area as extirpated (Mountain Caribou Technical Advisory Committee 2002) and it was not included in the area identified by the Federal recovery strategy for caribou.

Although the habitat surrounding the Harper Creek mine was occupied by caribou in the late 1980s and early 1990s, only three sets of caribou tracks were recorded in field studies for the Project between 2008 and 2011 (Appendix 15-A). The area is rarely used by caribou today because of fragmentation, past and current forest harvesting, and high road density. The Project is not in an area where caribou recovery is possible. Therefore, no residual effects are predicted for mountain caribou.

16.6.12.2 Residual Effects

Table 16.6-39 provides a summary of mitigation measures for mountain caribou, effectiveness of mitigation, and whether there is a predicted residual effect after mitigation. Because caribou are not present in the LSA, there are no effects or mitigation for caribou (as described above in Section 16.6.12.1).

Table 16.6-39. Proposed Mitigation Measures and their Effectiveness for Mountain Caribou

Mountain Caribou			
Potential Effects	**Proposed Mitigation Measure**	**Effectiveness** *(Low, Moderate, High, Unknown)*	**Potential Residual Effect** *(Y/N)*
Habitat Alteration and Loss	N/A	N/A	N
Disturbance and Displacement	N/A	N/A	N
Mortality	N/A	N/A	N

16.6.13 Mule Deer

16.6.13.1 Risk Ratings for Potential Effects

Mule deer were assessed for potential Project-related effects (Table 16.6-40). Habitat alteration and loss, and mortality were considered for the effects assessment. Neither effect was considered residual after mitigation (Sections 16.6.13.3 and 16.6.13.4 provide further information). The effect of disturbance and displacement was scoped out of the mule deer assessment.

Table 16.6-40. Risk Ratings of Project Effects on Mule Deer

Potential Effect Category	**Potential Effects Considered**	**Phase in which Potential Effects may Occur**		
		Construction	**Operations**	**Closure and Post-Closure**
Habitat Alteration and Loss	Habitat Loss	●	●	
Disturbance and Displacement	Noise Disturbance			
Mortality	Vegetation Clearing and/or Building Demolition			
	Wildlife-Vehicle Collisions	●	●	
	Power Line			
	Nuisance Animals			

Notes:
blank = No interaction expected; no monitoring required, no further consideration warranted.
● *= Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; if minor, may require monitoring; may warrant further consideration.*
● *= Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*
● *= Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

It is possible that a few individual deer are disturbed during construction activities during the summer months when they are expected to use the Project Site (Section 16.4.3.14; Appendix 15-A); however, summer is not the critical season for deer and it is predicted that there is a large amount of

suitable habitat available for mule deer in the region. Therefore, no interaction is expected for mule deer and disturbance and is not discussed further in the assessment.

16.6.13.2 Residual Effects

Table 16.6-41 provides a summary of mitigation measures for mule deer, effectiveness of mitigation, and whether there is a predicted residual effect after mitigation. The potential residual effects are described below in the following sections.

Table 16.6-41. Proposed Mitigation Measures and their Effectiveness for Mule Deer

Mule Deer			
Potential Effects	**Proposed Mitigation Measure**	**Effectiveness** *(Low, Moderate, High, Unknown)*	**Potential Residual Effect** *(Y/N)*
Habitat Alteration and Loss	Reclamation	Unknown	N
Disturbance and Displacement	N/A	N/A	N
Mortality	Traffic and Access Management Plan; speed limits.	High	N

16.6.13.3 Mule Deer Habitat Alteration and Loss

Winter habitat is generally considered to limit the number of mule deer that can be supported by a land base. BC MOE has mapped critical deer winter range (CDWR) in the area, and was used in the assessment. According to CDWR analysis a total of 355.6 ha of CDWR is located within the LSA, all at low-elevation areas along the North Thompson River Valley (see Appendix 15-A for details of habitat modelling). Approximately 1% of CDWR will be affected by the Project. This is considered negligible, and is no residual effect of habitat loss is anticipated for mule deer.

16.6.13.4 Mule Deer Mortality

The potential source of mortality for mule deer is wildlife-vehicle collisions in areas where roads used by the Project overlap high-quality deer habitat. Direct mortality of deer caused by vehicle collisions may occur during the proposed Project Construction, Operations, and Closure phases.

Vehicle Collisions

During the growing season (spring, summer, and fall), deer may frequent forest edge habitats, such as road verges, because they contain high-quality forage and provide easy movement. During the winter, access roads will require snow removal. Deer may preferentially use ploughed roads when the winter snowpack is deep. During baseline surveys (conducted in winter 2008 and 2011), one set of deer tracks was observed near Saskum Lake FSR (Section 16.4.3.14; Appendix 15-A). Implementation of the Traffic and Access Management Plan (Section 24.16) and mitigation such as adherence to speed limits and signage, will mitigate this effect. With mitigation, no residual effect of mortality on mule deer is anticipated.

16.6.14 Summary of Residual Effects on Wildlife

Table 16.6-42 provides a summary of residual effects and mitigation measures for the five wildlife species identified above as experiencing residual effects.

Table 16.6-42. Summary of Residual Effects on Wildlife

Valued Component	Project Phase (Timing of Effect)	Cause-Effect [1]	Mitigation Measure(s)	Residual Effect
Western toad	Construction, Operations	Loss of habitat due to the Project footprint (e.g., TMF and pit).	Reclamation of wetlands; creation of pocket wetlands.	Yes
Western toad	Operations through Closure	Mortality due to traffic along access roads or clearing activities.	Traffic reduction and imposed speed limits; avoid destruction of breeding sites; additional mitigation if necessary.	Yes
Harlequin Duck	Operations, Closure, and Post-Closure	Habitat alteration due to contamination and associated risk of adverse effects.	Selenium Mitigation Plan	Yes[2]
Olive-sided Flycatcher	Construction, Operations	Noise-disturbance and displacement.	Noise Management Plan	Yes
Grizzly bear	Construction, Operations	Loss of habitat due to vegetation clearing.	Avoidance, reclamation	Yes
Moose	Construction, Operations	Loss of habitat due to vegetation clearing construction – habitat alteration.	Avoidance, reclamation	Yes

[1] *"Cause-effect" refers to the relationship between the Project component or physical activity that causes a change or effect in the condition of a VC.*
[2] *Harlequin Ducks have not been recorded in the LSA, but an assessment for potential adverse effects due to contaminants was undertaken as a conservative measure, given that suitable potential habitat was recorded during field surveys along Harper Creek (See Appendix 15-A)*

16.7 SIGNIFICANCE ASSESSMENT FOR RESIDUAL EFFECTS

This section provides the significance determination for the residual effects summarised in Section 16.6.14, an evaluation of confidence in the significance determination, and a summary of the significance assessment for all residual effects.

16.7.1 Significance Determination

The assessment follows a two-step process in accordance with the Effects Assessment methods described in Section 8.6.5. First the severity of residual effects is ranked according to a minor, moderate and major scale (see Chapter 8, Figure 8.6-1). Secondly the scale is assigned a significance rating based on the descriptions below, primarily based on the magnitude of the effect and

professional judgement. The following definitions of the significance ratings are used to guide the significance ratings for wildlife VCs:

- **Not significant (minor or moderate scale)**: Residual effects have low or moderate magnitude; local to regional geographic extent; short- or medium-term duration; could occur at any frequency, and are reversible or partially reversible in either the short or long-term. The effects on the VC (e.g., at a species or local population level) are either indistinguishable from background conditions (i.e., occur within the range of natural variation as influenced by physical, chemical, and biological processes), or distinguishable at the individual level. Land and resource management plan objectives will likely be met, but some management objectives may be impaired.
- **Significant (major scale)**: Residual effects have high magnitude; regional or beyond regional geographic extent; duration is long-term or far-future; and occur at all frequencies. Residual effects on VCs are consequential (i.e., structural and functional changes in populations, communities, and ecosystems are predicted) and are irreversible. The ability to meet land and resource management plan objectives is impaired.

Of the 14 wildlife VCs considered in the effects assessment, five (western toad, Harlequin Duck, Olive-sided Flycatcher, grizzly bear, and moose) may experience residual effects, as described in the previous sections (Sections 16.6.1 through 16.6.13). Significance determinations for these five VCs are presented below (Sections 16.6.15.1 through 16.6.15.5).

16.7.1.1 Western Toad

Two residual effects are predicted for western toads: habitat loss and mortality. The characterization of the effects is presented in Tables 16.6-6 and 16.6-7.

Western toad habitat loss is predicted to result in a medium magnitude effect. Approximately 53 ha or 74% of mapped breeding habitat in the LSA will be lost as a result of Project Construction and Operations. With mitigation (creation of clean pocket wetlands conducive to western toad breeding in combination with reclamation of wetlands in the LSA) will reduce the magnitude of the effect, as approximately 30% of available wetlands in the LSA would be lost. Creation of alternative breeding ponds onsite will likely maintain breeding opportunities in the area. With mitigation, the effect of habitat loss on western toads is assessed as **not significant** (moderate).

Western toad mortality is predicted to result in a low magnitude effect due to vehicle collisions and construction clearing activities. Vegetation clearing activities will be avoided in identified breeding ponds from May through August, unless pre-clearing surveys are conducted. If tadpoles or toadlets are observed, these sites will be adaptively managed (e.g., buffer zones or relocation). Furthermore, if western toad migrations are observed, mitigation measures will be employed as appropriate to reduce potential traffic mortality. With mitigation, the effect of mortality on western toad is assessed as **not significant** (minor).

16.7.1.2 Harlequin Ducks

One residual effect is predicted for Harlequin Duck: habitat alteration due to presence of potential contaminants. The characterization of the effects is presented in Table 16.6-15.

Harlequin Ducks may experience a moderate magnitude effect of habitat alteration due to contaminants. Some habitat along upper Harper Creek (HT and HP modelling nodes) is predicted to have levels of Se above BC WQGs, but below toxicity thresholds for birds. Residual effects in upper Harper Creek are assessed to be **not significant** (minor). Although the magnitude of the residual effect on Harlequin Ducks is considered medium, use of the area by Harlequin Ducks has not been documented, and levels will remain below toxicity thresholds for birds.

16.7.1.3 Olive-sided Flycatcher

One residual effect is predicted for Olive-sided Flycatcher: disturbance and displacement. The characterization of the effect is presented in Table 16.6-20.

Olive-sided Flycatcher disturbance and displacement is predicted to result in a low magnitude effect. During Construction and Operations, approximately 8% and 10% of available habitat in the LSA, respectively, may be disturbed due to continuous Project noise. During Closure, impacts of noise will be reduced. The effect of disturbance and displacement on Olive-sided Flycatchers is assessed as **not significant** (minor).

16.7.1.4 Grizzly Bear

One residual effect is predicted for grizzly bears: habitat loss. The characterization of the effect is presented in Table 16.6-33.

Grizzly bear habitat loss is predicted to result in a medium magnitude effect. Approximately 20% of potential summer feeding habitat and 29.6% of potential fall feeding habitat may be removed; however, the area has been heavily disturbed by previous human development (e.g., forest harvesting leading to habitat fragmentation) and current human recreation, which has reduced habitat effectiveness in the area and grizzly bears are not observed regularly in the LSA (Appendix 15-A). Mitigation and reclamation during Closure and Post-Closure will replace some of this habitat. Despite the loss of feeding habitat in the LSA, no high-suitability or "critical" habitat will be affected by the Project. The effect of habitat loss on grizzly bears is assessed as **not significant** (minor).

16.7.1.5 Moose

One residual effect is predicted for moose: habitat loss. The characterization of the effect is presented in Table 16.6-37.

Moose habitat loss is predicted to result in a low magnitude effect. Approximately 1% of critical moose winter range will be affected by the Project. Approximately 77% of potential (moderate quality) growing season habitat in the LSA may be lost; however, this is not a limiting season for moose, and there is no evidence of use of this habitat by moose. Moose are relatively common and

widespread throughout BC, and no high suitability habitat exists in the high-elevation areas where the greatest Project effects are expected to occur. The effect of habitat loss on moose is assessed as **not significant** (minor).

16.7.2 Confidence and Uncertainty in Determination of Significance

Confidence, which can also be understood as the level of uncertainty associated with the assessment, is a measure of how well residual effects are understood and the confidence associated with the baseline data, modelling techniques used, assumptions made, effectiveness of mitigation, and resulting predictions.

Confidence is based on an evaluation of the scientific certainty in the review of Project-specific data, relevant literature, and professional opinion. Definitions of the confidence descriptors can be found in Table 16.7-1. Confidence in the significance of effects for the five wildlife VCs is described below (Section 16.7.2.1 through 16.7.2.5).

Table 16.7-1. Attributes of the Confidence in the Significance or Likelihood of the Effects

Low	The cause-effect relationships are poorly understood, there are a number of unknown external variables, and data for the Project Site are incomplete. The effectiveness of the mitigation measures may not yet be proven. High degree of uncertainty and final results may vary considerably.
Moderate	The cause-effect relationships are not fully understood, there are a number of unknown external variables, or data for the Project Site are incomplete. The effectiveness of mitigation measures is moderately well understood. There is a moderate degree of uncertainty; while results may vary, predictions are relatively confident.
High	There is a good understanding of the cause-effect relationship and all necessary data are available for the Project Site. The effectiveness of the mitigation measures is well known. There is a low degree of uncertainty, and variation from the predicted effect is expected to be low.

16.7.2.1 Western Toad

The confidence in the assessment of western toad habitat loss is **low**. Identification of western toad breeding habitat using habitat suitability modelling is not considered very accurate (see Section 15.4.3.3). Western toads can breed within small pools such as roadside ditches that cannot be identified with the current mapping scale. Furthermore, much of the wetland and meadow habitats occur adjacent to each other in a complex of wetlands, meadows and forested upland habitat within the TMF footprint. Due to the limitations of TEM mapping, it was difficult to differentiate between wetlands and meadows in the LSA. This may have resulted in an overestimate of the potential area of wetland affected. The creation of pocket wetlands conducive to western toad breeding, and reclamation of wetlands onsite should maintain an active breeding population in the LSA. However, the success of wetland reclamation and toad breeding habitat creation at high elevations is unknown.

The confidence in the assessment of western toad mortality is **moderate**. There is a good understanding of the cause-effect relationship, but there are some unknown variables, such as the frequency of traffic and vehicle collisions with toads. The effectiveness of mitigation measures (i.e., pre-clearing surveys and adaptive mitigation along roads) are moderately understood.

16.7.2.2 Harlequin Ducks

The confidence in the assessment of Harlequin Duck habitat alteration due to the presence of potential contaminants is **moderate**. Water quality modelling predicts selenium levels above BC WQG, and there is a moderate level of confidence in the modelling results (Section 13.5.6 and Appendix 13-C). Habitat alteration (i.e., predicted increase in selenium concentration in water relative to background conditions due to the Project) in upper Harper Creek is likely. Although there is uncertainty whether Harlequin Ducks use upper Harper Creek, it is unlikely that effects would occur since predicted concentrations are below toxicity thresholds. Therefore, confidence is moderate.

16.7.2.3 Olive-sided Flycatcher

The confidence in the assessment of Olive-sided Flycatcher disturbance and displacement is **moderate**. The amount of habitat affected is considered relatively accurate; however, the response of Olive-sided Flycatcher to continuous noise is unknown. Response to noise for similar species were evaluated using literature referenced in section 16.6.5 to improve the confidence in this assessment.

16.7.2.4 Grizzly Bear

The confidence in the assessment of grizzly bear habitat loss is **moderate**. The available habitat has been mapped and the habitat loss effects are well understood. However, the high road density and resulting disturbance has likely decreased the habitat effectiveness in the area. Loss of effectiveness of habitat for grizzly bears due to human influences is well documented and road density thresholds are commonly used to assess potential occupancy of suitable habitat by grizzly bears. Consequently, the amount of suitable habitat mapped in the LSA is likely an overestimate, and the habitat effectiveness is currently low.

16.7.2.5 Moose

The confidence in the assessment of moose habitat loss is **moderate**. Moose are relatively well understood with regards to habitat preferences and limiting factors. The Project will not affect critical moose winter habitat, which is the limiting season/habitat for moose. The Project footprint will remove summer habitat. Moose summer range is not critical or limiting.

16.7.3 Summary of the Significance Assessment for Residual Effects on Wildlife

Table 16.7-2 provides a summary of residual effects, mitigation measures, and significance determinations for the residual effects for the five wildlife species identified throughout Section 16.6.

Table 16.7-2. Summary of Key Effects, Mitigation, Residual Effects Characterization Criteria, Likelihood, Significance, and Confidence

Key Effect	Mitigation Measures	Summary of Residual Effects Characterization Criteria *(Magnitude, Geographic Extent, Duration, Frequency, Reversibility, Resiliency)*	Likelihood *(High, Moderate, Low)*	Significance of Adverse Residual Effects		Confidence *(High, Moderate, Low)*
				Magnitude (*High, Moderate, Low*)	Rating *(Not Significant; Significant)*	
Western Toads – Habitat Loss	Reclamation of wetlands; creation of pocket wetlands.	A medium magnitude effect on western toad breeding habitat is expected as a result of Project Construction. The majority of breeding habitat will be lost in the TMF. Habitat loss is discrete, will be into the future (effect lasts into Post-Closure), it is expected to occur sporadically during Construction and Operations, will be partially reversible with reclamation, and resiliency of toads is neutral.	High	Moderate	Not Significant	Low
Western Toads - Mortality	Traffic reduction and imposed speed limits; avoid destruction of breeding sites; additional mitigation if necessary.	A low magnitude effect on western toad mortality is expected after mitigation. Mortality will be discrete (limited to the Project Site) and may occur regularly, and will remain long-term (into the Closure phase but not beyond). The effect is reversible when activities cease, and the resilience of western toads in response to mortality is low because they are a SARA listed species (Schedule 1).	Moderate	Low	Not Significant	Moderate

(continued)

Table 16.7-2. Summary of Key Effects, Mitigation, Residual Effects Characterization Criteria, Likelihood, Significance, and Confidence (continued)

Key Effect	Mitigation Measures	Summary of Residual Effects Characterization Criteria *(Magnitude, Geographic Extent, Duration, Frequency, Reversibility, Resiliency)*	Likelihood *(High, Moderate, Low)*	Significance of Adverse Residual Effects		Confidence *(High, Moderate, Low)*
				Magnitude (*High, Moderate, Low*)	Rating *(Not Significant; Significant)*	
Harlequin Ducks – Habitat Alteration	Selenium Management Plan	A medium magnitude effect on Harlequin Duck habitat along upper Harper Creek is predicted. The effect will occur in Harper Creek in the RSA (regional extent) and duration of contaminant exposure above guidelines is predicted to occur regularly and into the future. The effect is partially reversible after levels return to below guidelines, and Harlequin Ducks have neutral resiliency, as selenium levels will remain below toxicity thresholds for birds.	Low	Moderate	Not Significant	Moderate
Olive-sided Flycatcher – Disturbance and Displacement	Noise management plan	A low magnitude effect of Olive-sided Flycatcher disturbance and displacement is expected as a result of Project Construction and Operations. Continuous noise levels will be above thresholds within the LSA (local extent). The frequency of this noise will be continuous and will remain until the end of Operations (medium-term duration). During Closure, noise levels will be greatly reduced; therefore, the impacts to are expected to be reversible. The resiliency of Olive-sided Flycatcher is considered neutral, as they may be able to respond and adapt to the effect of noise.	Low	Low	Not significant	Moderate

(continued)

Table 16.7-2. Summary of Key Effects, Mitigation, Residual Effects Characterization Criteria, Likelihood, Significance, and Confidence (completed)

Key Effect	Mitigation Measures	Summary of Residual Effects Characterization Criteria *(Magnitude, Geographic Extent, Duration, Frequency, Reversibility, Resiliency)*	Likelihood *(High, Moderate, Low)*	Significance of Adverse Residual Effects		Confidence *(High, Moderate, Low)*
				Magnitude (*High, Moderate, Low*)	Rating *(Not Significant; Significant)*	
Grizzly bear – Habitat Alteration	Site reclamation, road decommissioning	A moderate magnitude effect of grizzly bear habitat loss is expected as a result of Project Construction. Effects are expected to be discrete (limited to the Project Site), into the future, and will occur sporadically during Construction and Operations. The effect is partially reversible, as some habitat will be reclaimed during Closure, but will not return to pre-construction conditions until well into Post-Closure. The resiliency is high, as the area has been heavily disturbed already and grizzly bears do not currently use the area.	Low	Low	Not Significant	Moderate
Moose – Habitat Alteration	Site reclamation, road decommissioning	A low magnitude effect of moose habitat loss is expected as a result of Project Construction. Effects are expected to be discrete (limited to the Project Site), into the future, and will occur sporadically during Construction and Operations. The effect is partially reversible with reclamation of some areas. The resiliency is high, as the area has been heavily disturbed already and moose can likely respond and adapt to the effect.	Moderate	Low	Not Significant	Moderate

16.8 CUMULATIVE EFFECTS ASSESSMENT

The cumulative effects assessment (CEA) considers the effects on wildlife and wildlife habitat that are likely to result from the residual environmental effects of the Project in combination with the effects of other projects and activities that have been or are likely to be carried out in the same area as the Project. The CEA methodology is based on the framework outlined by the *Canadian Environmental Assessment Act* (1992) guidelines (Hegmann et al. 1999) with additional guidance provided in the AIR. The following steps are taken in this CEA:

The method follows that described in Chapter 8 which involves the following key steps which are further discussed in the following sub-sections:

- scoping;
- analysis;
- identification of mitigation measures;
- identification of residual cumulative effects; and
- determination of significance.

16.8.1 Scoping Cumulative Effects

The scoping process involves identification of the receptor VCs for which residual effects are predicted, definition of the spatio-temporal boundaries of the assessment, and an examination of the relationship between the residual effects of the Project and those of other projects and activities.

16.8.1.1 Valued Components and Project-related Residual Effects

Receptor VCs included in the wildlife CEA were selected using four criteria following the BC EAO (2013):

- there must be a residual environmental effect of the Project;
- that environmental effect must be demonstrated to interact cumulatively with the environmental effects from other projects or activities;
- it must be known that the other projects or activities have been or will be carried out and are not hypothetical; and
- the cumulative environmental effect must be likely to occur.

The CEA is organized by VC, as each VC is influenced by different projects, over different spatial and temporal scales. Wherever possible, the CEA uses quantitative information and thresholds/land use objectives; however, in cases where quantitative assessment is not possible due to insufficient regional information, or where thresholds or land use objectives have not been developed for the species, a qualitative assessment is used.

The residual effects assessment in Section 16.6 identified five VCs that are expected to have a residual effect (as summarized in Table 16.6-42):

- western toad;
- Harlequin Duck;
- Olive-sided Flycatcher;
- grizzly bear; and
- moose.

These five VCs were carried forward into this CEA in accordance with the methodology described in Chapter 8.

16.8.1.2 Defining Assessment Boundaries

Similar to the Project-related effects, assessment boundaries (temporal and spatial) define the maximum limit within which the cumulative effects assessment is conducted. Boundaries relevant to wildlife CEA are described below.

The temporal boundaries for the identification of physical projects and activities have been categorized into past, present, and reasonably foreseeable projects and are defined as follows:

- **Past**: no longer operational projects and activities that were implemented in the past 50 years. This temporal boundary enables to take into account any far-future effects from past projects and activities[1].
- **Present**: active and inactive projects and activities; and
- **Future**: certain projects and activities that will proceed, and reasonably foreseeable projects and activities that are likely to occur. These projects are restricted to those that 1) have been publicly announced with a defined project execution period and with sufficient project details for assessment; and/or 2) are currently undergoing an environmental assessment, and/or 3) are in a permitting process.

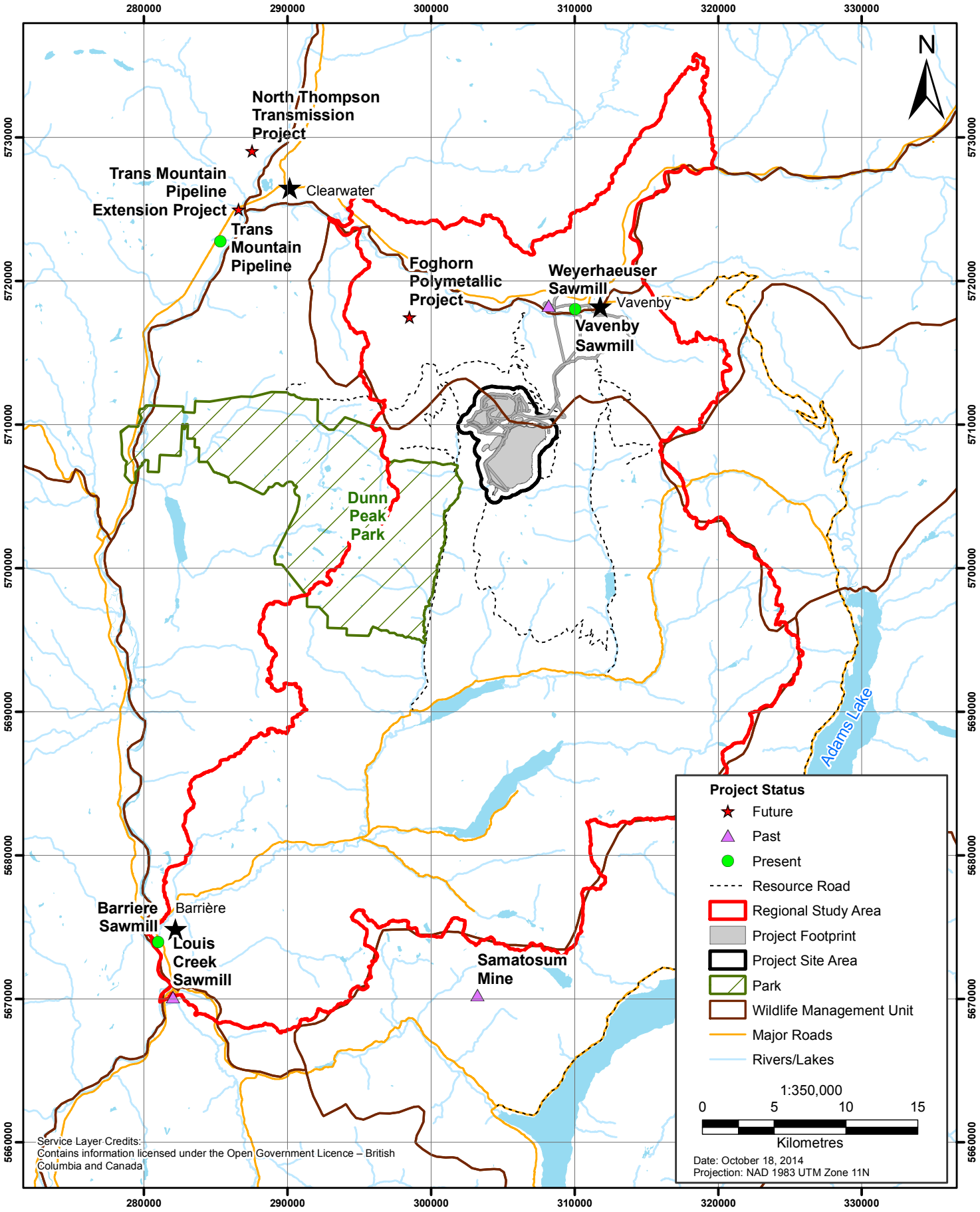
The CEA spatial boundary limit for the Project is defined in the AIR as the Kamloops LRMP boundary[2] (see Section 8.7-1). In order to focus the CEA on potential interactions between the identified residual effects for wildlife and the residual effects of other projects and activities, the CEA boundary for wildlife VCs is defined as the RSA. The RSA consists of the Vavenby and Barriere Landscape Units, and encompasses the Project, the LSA, and the broader surrounding area where there is potential for an interaction of the proposed Project with past, present, and future activities. The RSA is a total size of 150,010 ha (Figure 16.3-2 and 16.8-1).

[1] Far-future effects are defined as effects that last more than 37 years, as per Table 8.6-2: Attributes for Characterization of Residual Effects.

[2] Note that the CEA area only refers to the spatial boundaries for the identification of other physical projects and activities, i.e., the Kamloops LRMP boundary. Each assessment chapter will define its own spatial and temporal boundaries.

Figure 16.8-1

Location of Past, Present and Reasonably Foreseeable Future Projects for the Cumulative Effects Assessment for Wildlife



16.8.1.3 Projects and Activities Considered

The past, present, and reasonably foreseeable future projects and activities considered in the CEA are presented in Chapter 8 in Tables 8.7-1 and 8.7-2, respectively. Figure 16.8-1 shows the past, present and future projects that fall within the CEA boundary for wildlife.

All Project-related residual effects were considered for their potential to interact with the projects and activities identified within the CEA area. A map indicating the location of past, present, and reasonably foreseeable future projects within the wildlife CEA area is provided in Figure 16.8-1. Figure 16.8-2 shows the cumulative logging disturbance since 1960. Land use activities identified in the CEA area includes the following (as mapped in the figures in Section 8.7):

- trapping: trapline tenure (7) and trapline cabin tenure (0);
- non-commercial recreation: protected area (1 – Dunn Peak Protected Area); recreation cabin (3 - Foghorn snowmobile cabin, Harp cabin, and Avery lookout); recreation site for fishing, camping and hunting (1: Saskum Lake south), and recreation trail (2 - Foghorn-Harp snowmobile trail, and Dunn Peak trail);
- public and commercial recreation tenure: commercial recreation (3: guided freshwater recreation and snowmobiling); environment conservation and recreation (2); private campground (1: Clearwater-Birch Island Campground); potential pullout area for snowmobile (2); and the Serenity Performing Arts Centre;
- mineral exploration: mineral claims (161); mineral leases (0); and placer claims (0);
- agriculture: range tenure (7), agricultural land reserve (11) and the Vavenby Trail Ride;
- forestry: active cutblocks (93); community forest (1);
- water use: water intake extraction points (64) and water licences (173); and
- private lands (494).

These land use and activities are screened and analyzed for cumulative effects in the following section.

16.8.2 Screening Cumulative Effects

All past, present and reasonably foreseeable future projects located within the wildlife CEA area (the RSA) were included in the impact matrix for screening and ranking of potential cumulative effects (Table 16.8-1). A ranking of low, moderate, and high risk of adverse cumulative effect was calculated for each VC that was found to have a residual effect. The same risk ratings used for Project effects on wildlife were used in the CEA, with green indicating low-risk interaction, yellow indicating moderate-risk interaction, and red indicating high-risk interaction. Rankings were determined based on a combination of factors (e.g., location of projects/activities relative to wildlife habitat) and included qualitative assessments and professional judgement. Quantitative assessments were not possible, as no data were available for the RSA or from other projects. Those projects/activities that were given a score of moderate or major adverse effect are justified below.

Figure 16.8-2

Cumulative Logging Disturbance Pre-1960 to Present in the Regional Study Area

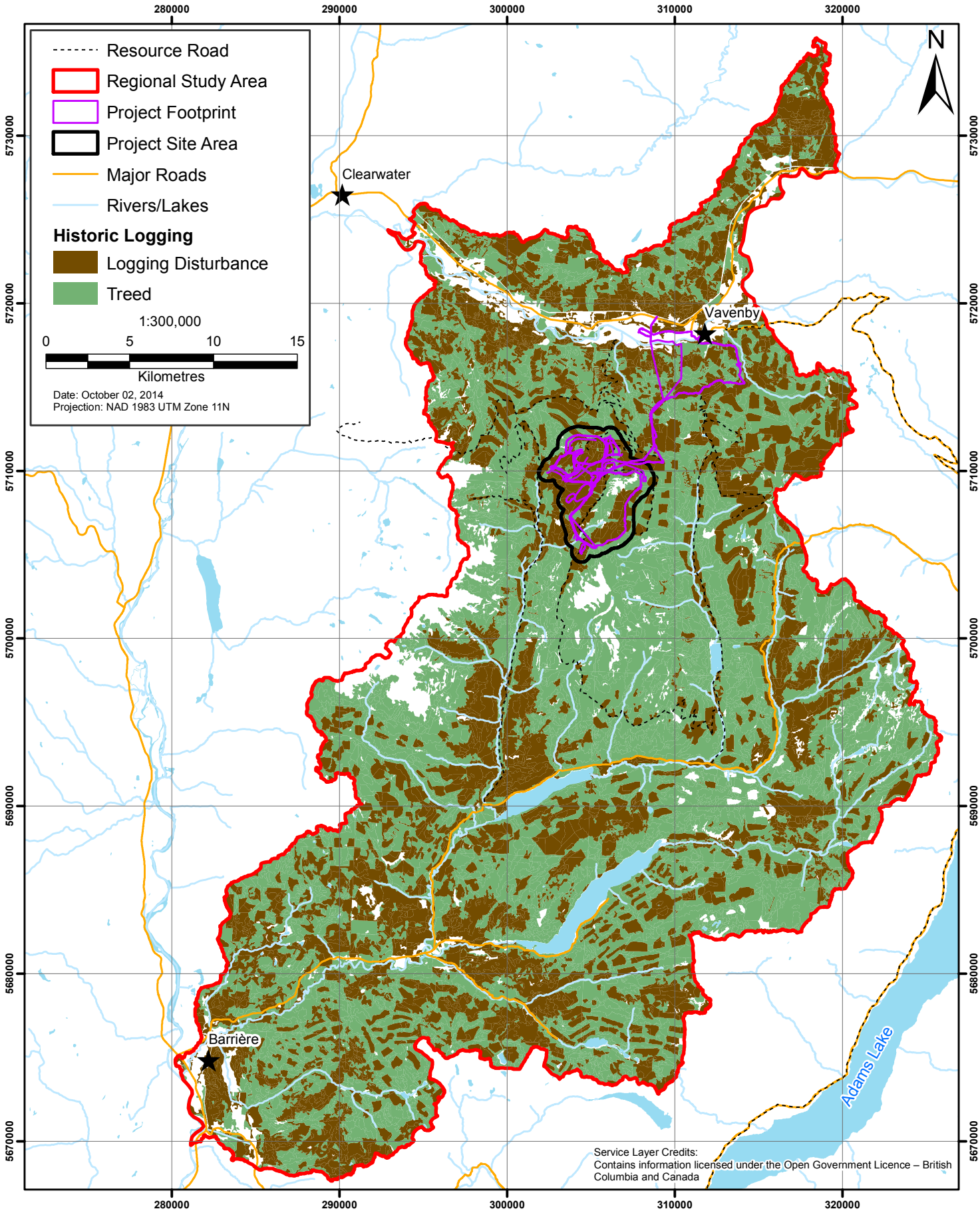


Table 16.8-1. Impact Matrix for Screening and Ranking Potential Cumulative Effects on Wildlife

Residual Effects of the Harper Creek Project on VCs	Past Projects		Present Projects			Reasonably Foreseeable Future Projects			Activities											
	Weyerhaeuser Sawmill	Louis Creek Sawmill	Trans Mountain Pipeline	Vavenby Sawmill	Barriere Sawmill	North Thompson Transmission Project	Trans Mountain Pipeline Expansion	Foghorn Project	Aboriginal Harvesting	Hunting	Trapping	Fishing	Non-commercial Recreation	Commercial Recreation	Mineral Exploration	Transportation	Agriculture	Forestry	Water Use
Western Toad																			
Habitat Loss	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Mortality	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Harlequin Duck																			
Habitat Alteration - Contaminants	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Olive-sided Flycatcher																			
Disturbance and Displacement	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Grizzly bear																			
Habitat Loss	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Moose																			
Habitat Loss	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Notes:

● = *Negligible to minor risk of adverse cumulative effect; will not be carried forward in the assessment.*

● = *Moderate risk of adverse cumulative effect; will be carried forward in the assessment.*

● = *Major risk of adverse cumulative effect or significant concern; will be carried forward in the assessment.*

16.8.2.1 Past Projects

The Weyerhaeuser Sawmill historically operated within the CEA area for wildlife; however, the Weyerhaeuser Sawmill has been closed since 2003 with no plans for resuming operation. The property, now owned by Yellowhead Mining Inc., is proposed for use by the Project for concentrate storage, rail access, and staging grounds. No data are available on the past residual effects of the Weyerhaeuser Sawmill on wildlife. The Weyerhaeuser Sawmill is located within CMWR habitat, which is considered the most limiting habitat for moose. Therefore, this past project is considered in the CEA for moose.

The Louis Creek Sawmill was also within the wildlife CEA area, but it burned down in 2003 and was never rebuilt.Therefore this past project will not be carried forward in the CEA.

16.8.2.2 Present Projects

Three present projects are within the CEA area for wildlife: Trans Mountain Pipeline, Vavenby Sawmill, and Barriere Sawmill. No data are available on the residual effects of the Barriere and Vavenby sawmills on the five VCs considered in the CEA. The interaction between the Barriere Sawmill and the Project is considered low-risk with the potential to result in negligible effects, and is therefore not carried forward in the CEA.

The Vavenby Sawmill is considered to contribute to the cumulative effects of habitat loss on moose and noise disturbance on Olive-sided Flycatcher. The Vavenby Sawmill is located within CMWR habitat, which is considered the most limiting habitat for moose, potentially contributing to habitat loss. The potential noise sources from Vavenby Sawmill may include lumber processing and traffic along the access road. Lumber processing noise is considered to be localized enough for there to be minimal interaction with noise produced by the activities associated with Project Construction and Operations. Although there is a possibility of interaction between the Project (Construction and Operations phases) and Vavenby Sawmill, this interaction is considered moderate-risk with the potential to result in minor adverse effect.

No information on residual effects to VCs as a result of the Trans Mountain Pipeline construction in 1953 is available. In 1997 an upgrade to the pipeline was not expected to have any residual effects to wildlife. The Trans Mountain Pipeline within the RSA is located within CMWR habitat, which is considered the most limiting habitat for moose. Because the pipeline follows the highway, it is unlikely that this pipeline project has reduced CMWR habitat. The interaction between the Trans Mountain Pipeline and the Project is considered low-risk with the potential to result in negligible effects, and is therefore not carried forward in the CEA.

16.8.2.3 Reasonably Foreseeable Future Projects

Three reasonably foreseeable future projects are within the CEA area for wildlife: the North Thompson Transmission Project; the Trans Mountain Pipeline Expansion; and the Foghorn Project. The North Thompson Transmission Project planning is currently on hold because the industrial load in the North Thompson area has not been confirmed. At this stage it is unclear which route the transmission line will take and whether a residual effect is expected. One proposed route is through

the NW corner of the RSA, within CMWR habitat, which is considered the most limiting habitat for moose. If this route is selected a moderate risk of adverse cumulative effect is anticipated.

The Trans Mountain Pipeline expansion project applied to the National Energy Board for authorization in December 2013. The section of Trans Mountain Pipeline within the RSA is located within CMWR, which is considered the most limiting habitat for moose. By twinning the pipeline, several ha of CMWR habitat may be lost. Because the pipeline follows the highway, it is unlikely that this project will greatly impact use of the area by moose, which tend to avoid highways. Nevertheless, because it is within CMWR, the Trans Mountain Pipeline is considered moderate-risk for cumulative effects of habitat loss on moose.

The Foghorn Polymetallic Project is a mineral claim and proposed uranium mine; however, the project is currently on hold due to a provincial ban on uranium exploration and mining. It is uncertain if the Foghorn Polymetallic Project will start construction before the end of the Project's life of mine. There are negligible effects from the proposed Harper Creek Project at the location of the proposed Foghorn Polymetallic Project. Due to the low likelihood of a cumulative residual effect, and the unknown timeline of the Foghorn Polymetallic Project, further assessment is not warranted.

16.8.2.4 Activities

Several activities were deemed to have a moderate risk of cumulative effect due to the sensitivity of several wildlife VCs to increasing road density. Within the RSA, 56,443 ha have been logged since the forest industry began operations in the area, according to recent VRI. This accounts for 37.6% of the RSA (Figure 16.8-2). Approximately half of the logging to date occurred prior to 1960. The remaining forest is fragmented, which has been exacerbated by increasing road density and grazing. Most of the roads are actively used by forestry, agriculture, mineral exploration, recreational users (both commercial and non-commercial) and travelers (driving between the towns of Vavenby and Barriere). Grizzly bears are particularly sensitive to increasing road density. Transportation also has the potential to have moderate risk of adverse cumulative effect for western toad. Toads are particularly susceptible to road mortality, particularly during mass migration.

16.8.3 Mitigation Measures

Mitigation measures that could be applied to reduce the contribution of the Project to cumulative effects were identified and considered for their effectiveness in accordance with the methodology described in Chapter 8, Section 8.7.3. Table 16.8-2 outlines the means by which mitigation of cumulative effects was considered in the assessment.

16.8.4 Cumulative Residual Effects and Characterization

16.8.4.1 Potential Cumulative Residual Effect on Western Toad

Two residual effects on western toad identified for the Project (habitat loss and mortality) may interact with other projects or activities in the RSA. The CEA for these two effects are described below.

Table 16.8-2. Proposed Mitigation Measures for Potential Cumulative Effects and their Effectiveness

Potential Cumulative Effect	Proposed Mitigation Measure	Mitigation Effectiveness *(low/moderate/high/unknown)*
Habitat Loss (western toad, grizzly bear, moose)	Site reclamation, road decommissioning, wetland creation	Moderate
Habitat Alteration due to Contaminants (Harlequin Duck)	Selenium Management Plan	Unknown
Mortality (western toad)	Monitoring and adaptive management	Moderate
Disturbance and Displacement (Olive-sided Flycatcher)	Noise Management Plan	Moderate

Habitat Loss

The residual effects assessment for western toads (Section 16.6.1) predicts a medium magnitude residual effect of habitat loss. This effect was not significant (moderate) after mitigation, as wetlands will be reclaimed and/or created to replace some of this loss. This residual effect was brought forward in the CEA, which considers all sources of likely residual habitat loss effects due to past, existing, and foreseeable future projects and land use activities (Table 16.8-1) that could affect toads within the RSA. All projects and activities considered in the CEA are considered to present a negligible to minor risk of adverse cumulative effect. The assessment is qualitative and based on professional judgement.

Wetlands within the RSA are expected to receive a high level of protection under the Forest and Range Practices Act (FRPA), as the majority of existing disturbance in the area is due to forestry. Riparian management guidelines and vegetation buffers required around wetlands will reduce the potential cumulative effect on toad habitat loss. Creation of "pocket wetlands", reclamation, and a monitoring program (Section 16.8.7) by the Project is expected to mitigate the effect of habitat loss on western toads. Because of management guidelines around riparian habitat and mitigation measures to be implemented for the Project to mitigate effects of habitat loss on western toads, no cumulative residual effect is anticipated.

Mortality

The residual effects assessment for western toad (Section 16.6.1) predicts a low magnitude residual effect of mortality for western toad that was not significant (minor) with mitigation. This residual effect was due to predicted risks associated with vehicle collisions during movements/migrations or due to vegetation clearing/construction activities. This residual effect is brought forward into the CEA, which considers all sources of direct mortality due to relevant projects that could affect western toad populations within and surrounding the Project (Table 16.8-1).

Mortality due to cumulative effects of vegetation clearing and use of heavy machinery during construction of multiple projects in the RSA could result in western toad mortality. This effect can be mitigated if construction activities of various projects occur outside of the breeding period, or if occurring during the breeding season, surveys are conducted to mitigate the cumulative effect.

A qualitative assessment of the potential effects of activities on western toad mortality due to vehicles was conducted by examining all activities that would involve vehicular transport near areas with potential western toad habitat. Vehicular traffic and heavy machinery use associated with transportation, hunting, trapping, recreation (commercial and non-commercial), mineral exploration, forestry and agriculture all have the potential to cause a moderate adverse cumulative effect to western toad mortality. Roads in close proximity to breeding sites can lead to toad mortality when adults migrate to breeding sites in the spring and toadlets migrate from these same sites in mid-summer. Western toad breeding can occur in a wide range of areas, including road-side ditches. There is a pre-existing high (1.21-2.40 km/km^2) or very-high (greater than 2.40 km/km^2) baseline road density for 81.7% of the LSA (see Table 16.4-2). A road density analysis was not conducted for the RSA, but a qualitative review of existing roads in the area suggests similar densities throughout the RSA. Reducing speed limits and adaptive mitigation (e.g., installing culverts) if necessary will reduce the amount of road mortality. Reclamation during closure and decommissioning of roads within the Project Site will further reduce mortality effects as a result of decreased vehicular traffic.

Western toad mortality due to vehicles and clearing activities may occur as a result of past, present, and reasonable foreseeable future projects. It is predicted that the potential cumulative effect of mortality may result in a cumulative residual effect to western toads, regardless of the Project.

Characterization of Cumulative Residual Effect of Mortality on Western Toad

The cumulative residual effects are characterized and evaluated using the same criteria and definition thresholds established for the Project-specific effects (see Table 16.6-1). Table 16.8-3 characterizes the cumulative residual effects of mortality on western toad.

Table 16.8-3. Characterization of Cumulative Residual Effect of Mortality on Western Toad

Criterion	Characterization	Explanation
Magnitude	Medium	Road mortality is usually site specific (near wetlands) and seasonal, but cumulatively, there could be between 10-30% change from baseline. This effect is predicted to be pre-existing and is occurring/will occur regardless of the Harper Creek Project.
Geographic Extent	Regional	Road construction and use throughout the RSA is expected to result in toad mortality.
Frequency	Sporadic	Toad mortality is seasonal and usually associated with roads along wetlands.
Duration	Future	Mortality in the RSA will continue in the future, as long as the existing roads remain active.
Reversibility	Not Reversible	Ongoing use of roads for other activities and associated mortality is not reversible.
Resiliency	Neutral	Resiliency is considered neutral because, although western toads are listed on Schedule 1 of SARA, toad populations are also capable of persisting in areas with high road densities.

Likelihood of Cumulative Residual Effect of Mortality on Western Toad

The probability of a cumulative effect of mortality on western toads occurring is considered **moderate** (effect has 40 – 80% chance of effect occurring; Table 16.6-2). Activities from other projects within the RSA are expected to cause western toad mortality due mainly to vehicular mortality. Most of the pre-existing and ongoing mortality on forestry roads is not mitigated but western toads are widespread in BC (BC MWLAP 2004b). Mitigation measures identified below will employed during mine Construction and Operations to reduce the mortality of toads in the LSA compared to the RSA.

Mitigation Measures

The confidence in the characterization of the residual Project effects to western toads due to habitat loss was considered to be low. Habitat suitability modelling for western toad habitats using TEM can often overestimate the amount of suitable habitat available (see Section 15.4.3.3), and consequently, the amount of habitat potentially lost. Based on current information, the residual effect of western toad habitat loss is considered not significant (moderate) – the effect is not considered significant because it is expected that the amount of habitat lost due to the footprint is an overestimate.

To address this uncertainty, HCMC will survey wetland habitat and western toad breeding ponds within the footprint of the TMF and the pit prior to construction activities commencing in these areas. The approximate area of confirmed wetland breeding sites will then be used to ensure an appropriate amount of wetland habitat is created during reclamation or with the creation of "pocket wetlands" during the Construction and/or Operation phases.

Other measures to be implemented include:

- pocket wetlands for toads will be created, as discussed in the Closure and Reclamation Plan (Chapter 7);
- monitoring of pocket wetlands for western toad habitat will be also be undertaken to track the effectiveness of reclamation and support an adaptive management approach; and
- if western toad migrations are observed, mitigation measures will be employed as appropriate to reduce potential traffic mortality.

16.8.4.2 Potential Cumulative Residual Effects on Harlequin Ducks

Habitat alteration due to the presence of potential contaminants was the only residual effect considered for Harlequin Ducks. The only project that could potentially contribute to contaminants in the RSA is the Foghorn Project. However, there is no spatial interaction between areas experiencing selenium above BC WQG due to the Project (i.e., upper Harper Creek) and the Foghorn Project. No cumulative effects of habitat alteration due to contaminants are considered for Harlequin Duck.

16.8.4.3 Potential Cumulative Residual Effects on Olive-sided Flycatcher

The effect of disturbance and displacement due to noise was considered a residual effect in the effects assessment for Olive-sided Flycatcher, and this effect as the potential to interact with other projects or activities in the RSA.

Disturbance and Displacement

The residual effects assessment for Olive-sided Flycatcher (Section 16.6.5) predicts a low magnitude residual effect of disturbance and displacement on Olive-sided Flycatchers that was not significant (minor) with mitigation.

Olive-sided Flycatcher may be disturbed or displaced by continuous noise associated with roads and/or projects in the RSA. Although several projects and activities have the potential to have noise levels above wildlife guidelines, only the Vavenby Sawmill was considered to have a moderate chance of having an adverse cumulative effect due to its proximity to Olive-sided Flycatcher suitable habitat. The area has experienced high levels of human activity and development, and it is not expected that noise levels emitted from the sawmill will extend very far based on noise contour predictions for Project facilities in the area. A cumulative residual effect of disturbance and displacement of Olive-sided Flycatchers is anticipated due to the proximity of the Vavenby Sawmill to suitable Olive-sided Flycatcher habitat.

Characterization of Cumulative Residual Effects of Disturbance and Displacement on Olive-sided Flycatcher

The cumulative residual effects are characterized and evaluated using the same criteria and definition thresholds established for the Project-specific effects (see Table 16.6-1). Table 16.8-4 characterizes the cumulative residual effect of disturbance and displacement on Olive-sided Flycatcher.

Table 16.8-4. Characterization of Cumulative Residual Effect of Disturbance and Displacement on Olive-sided Flycatcher

Criterion	Characterization	Explanation
Magnitude	Low	Habitat near the mill is limited in extent based on LSA mapping and habitat is likely available elsewhere in the RSA.
Geographic Extent	Local	The effect is limited to Vavenby Sawmill and the Project and will therefore remain with the LSA at the local scale.
Frequency	Continuous	Noise will be constant.
Duration	Long term	Noise will continue while the mill and the Harper Creek Project are in operation, but will cease when closed.
Reversibility	Reversible	The effects to Olive-sided Flycatcher are expected to be reversible.
Resiliency	Neutral	Information on flycatchers suggest that habituation may be possible to long term noise.

Likelihood of Cumulative Residual Effect of Disturbance and Displacement on Olive-sided Flycatcher

The probability of a cumulative effect of disturbance and displacement on Olive-sided Flycatchers occurring is considered **low** (effect has <40% chance of effect occurring; Table 16.6-2). Surrounding the Vavenby Sawmill is moderate Olive-sided Flycatcher habitat that may be disturbed by the noise generated from sawmill activities. Due to the reversibility of the disturbance and displacement effects as well as the resilience of Olive-sided Flycatcher to continuous noise and availability of habitat outside of the LSA, the likelihood of a cumulative effect on Olive-sided Flycatcher is low.

16.8.4.4 Potential Cumulative Residual Effects on Grizzly Bear

The effect of habitat loss was considered a residual effect in the effects assessment for grizzly bears, and this effect as the potential to interact with other projects or activities in the RSA.

Habitat Loss

The residual effects assessment for grizzly bears (Section 16.6.10) predicts a medium magnitude residual effect of habitat loss on grizzly bears that was not significant (minor) with mitigation.

No quantitative data were available regarding grizzly bear habitat in the RSA; therefore, the road densities were used as a proxy for available and suitable habitat in the cumulative effects assessment of habitat loss on grizzly bears. The assessment of cumulative habitat loss on grizzly bears is primarily based on professional judgement.

Grizzly bears are particularly susceptible to the effects of road density and related uses and disturbance (Apps and Hamilton 2002; Ross 2002). Currently there is estimated to be a high road density within the RSA based on the extent of forestry development (Figure 16.8-1). Furthermore, hunting, trapping, recreation (commercial and non-commercial), mineral exploration, and agriculture have cumulatively resulted in reducing the suitability of habitat for bears over much of the RSA. The cumulative effect of habitat loss on grizzly bears is considered residual, primarily due to past activities in the RSA (i.e., it is a pre-existing effect), regardless of the Project.

Characterization of Cumulative Residual Effect of Habitat Loss on Grizzly Bear

The cumulative residual effects are characterized and evaluated using the same criteria and definition thresholds established for the Project-specific effects (see Table 16.6-1). Table 16.8-5 characterizes the cumulative residual effect of habitat loss on grizzly bears.

Likelihood of Cumulative Residual Effect of Habitat Loss on Grizzly Bear

Cumulative habitat loss on grizzly bears is considered a pre-existing effect due to past activities in the RSA; therefore, the probability of the effect is considered high (effect has > 80% chance of effect occurring), as it has already occurred, regardless of the Harper Creek Project or other future projects.

Table 16.8-5. Characterization of Cumulative Residual Effect of Habitat Loss on Grizzly Bear

Criterion	Characterization	Explanation
Magnitude	High	Pre-existing loss of habitat and high road densities have reduced the quality of habitat in the RSA for grizzly bears. Therefore, this effect is primarily driven by past projects, is pre-existing, and is occurring/will occur regardless of the Harper Creek Project.
Geographic Extent	Regional	Cumulative effects are expected to be regional; road density in the LSA and RSA is already high.
Frequency	Sporadic	Habitat loss has occurred or will occur sporadically (i.e., at sporadic intervals) in the RSA.
Duration	Far-future	This effect will continue into the far-future, as land management objectives support development in the RSA.
Reversibility	Partially Reversible	The effect may be partially reversed in the future if activities cease and areas are reclaimed.
Resiliency	Neutral	The area has been heavily disturbed by previous human development and grizzly bears are not currently using the area; therefore, the grizzly bear population may have already, or may be able to respond and adapt to the effect.

16.8.4.5 Potential Cumulative Residual Effects on Moose

The effect of habitat loss was considered a residual effect in the effects assessment for moose, and this effect as the potential to interact with other projects or activities in the RSA.

Habitat Loss

The residual effects assessment for moose (Section 16.6.11) predicts a low magnitude residual effect of habitat loss on moose that was not significant (minor) with mitigation. This assessment was primarily based on availability and loss of critical moose winter range (CMWR) in the LSA, as winter is the limiting season for moose.

The assessment of cumulative habitat loss on moose is primarily based on professional judgement. The proximity of past, present, and future activities and projects to CMWR habitat was used for the cumulative effects assessment. The Weyerhaeuser Sawmill, Vavenby Sawmill, Trans Mountain Pipeline, North Thompson Transmission Project, and Trans Mountain Pipeline Expansion are located within CMWR habitat, which is considered the most limiting habitat for moose. CMWR areas were designated in the Kamloops LRMP and are managed to maintain attributes beneficial to moose. Some growing season habitat in the RSA may be affected cumulatively due to past, present, and future activities/projects; however, this is not a limiting season for moose. The cumulative effect of habitat loss on moose is considered residual, primarily due to past activities in the RSA (i.e., it is a pre-existing effect) reducing the quality of growing season habitat for moose, regardless of the Project.

Characterization of Cumulative Residual Effect of Habitat Loss on Moose

The cumulative residual effects are characterized and evaluated using the same criteria and definition thresholds established for the Project-specific effects (see Table 16.6-1). Table 16.8-6 characterizes the cumulative residual effect of habitat loss on moose.

Table 16.8-6. Characterization of Cumulative Residual Effect of Habitat Loss on Moose

Criterion	Characterization	Explanation
Magnitude	Low	Approximately 1% of CMWR in the LSA will be affected by the Project. Forestry practices are managed to maintain habitat values for moose within CMWR.
Geographic Extent	Regional	Cumulative effects are expected to be regional in the RSA.
Frequency	Sporadic	Habitat loss has occurred or will occur sporadically (i.e., at sporadic intervals) in the RSA.
Duration	Long-term	Current land management objectives for moose in the RSA (CMWR) are established.
Reversibility	Partially Reversible	The effect of habitat loss can be partially reversed with reclamation of site, road closure, etc.
Resiliency	High	Moose in the RSA can respond and adapt to the effect.

Likelihood of Cumulative Residual Effect of Habitat Loss on Moose

Past, present and foreseeable future projects are not expected to reduce the amount of CMWR available in the RSA. Because the impact of the Project on CMWR is considered low, the likelihood of the cumulative effect occurring on moose is considered **low** (effect has < 40% chance of effect occurring).

16.8.4.6 Summary of Cumulative Residual Effects on Wildlife

A summary of cumulative residual effects on wildlife is presented in Table 16.8-7.

16.8.5 Significance of Cumulative Residual Effects

16.8.5.1 Western Toad

Mortality of western toads mainly on roads is predicted to occur throughout the RSA. Mitigation measures at the Project Site should reduce impacts of the Project compared to other areas in the RSA where no mitigations are applied. The cumulative effect of mortality on western toads is considered **not significant** (minor) both with and without the Harper Creek Project.

16.8.5.2 Olive-sided Flycatcher

Olive-sided Flycatcher may be disturbed or displaced by continuous noise due to the Vavenby Sawmill and the Harper Creek Project. The area has experienced high levels of human activity and development, and it is not expected that noise levels emitted from the sawmill will extend very far based on noise contour predictions for Project facilities in the area. The cumulative effect of disturbance and displacement on Olive-sided Flycatcher is considered **not significant** (minor) both with and without the Project**.**

Table 16.8-7. Summary of Cumulative Residual Effects on Wildlife

	Cause-Effect [1]	Mitigation Measure(s)	Cumulative Residual Effect
Western Toad			
Habitat Loss	Removal of suitable wetland habitat.	Riparian management guidelines; reclamation.	N
Mortality	Construction activities; traffic mortalities.	Riparian management guidelines; avoid known breeding sites during construction; adaptive mitigation along roads.	Y
Harlequin Duck			
Habitat Alteration	Habitat alteration due to contamination and associated risk of adverse effects.	Selenium Management Plan	N
Olive-sided Flycatcher			
Disturbance and Displacement	Noise disturbance from Vavenby Sawmill and the Project.	Noise Management Plans	Y
Grizzly Bear			
Habitat Loss	Pre-existing activities and projects in the RSA have reduced grizzly bear habitat availability. This effect is primarily driven by past projects, is pre-existing, and is occurring/will occur regardless of the Harper Creek Project.		Y
Moose			
Habitat Loss	Past, present, and future projects resulting in minimal loss of habitat in CMWR and growing season habitat in the RSA.	Kamloops LRMP	Y

[1] *"Cause-effect" refers to the relationship between the project/activity and the residual effect; describe what is causing the change or effect in the condition of the VC, indicator or discipline.*

16.8.5.3 Grizzly Bear

Considering the future-case scenario with the Project, the cumulative residual effect of habitat loss for grizzly bears is assessed as **not significant** (moderate). While this CEA identifies a not significant cumulative effect of habitat loss on grizzly bears (despite a high magnitude effect) as a result of increased cumulative habitat loss from future projects (including the Harper Creek Project), it is important to note that current habitat availability in the RSA is already considered low or fragmented prior to the Project and all other potential projects. Therefore, this CEA identifies this effect as already occurring, but is not significant.

16.8.5.4 Moose

The Weyerhaeuser Sawmill, Vavenby Sawmill, Trans Mountain Pipeline, North Thompson Transmission Project, and Trans Mountain Pipeline Expansion are located within CMWR habitat, which is considered the most limiting habitat for moose. Habitat within the CMWR is actively managed to maintain attributes favourable to moose. Edge habitats along linear clearings are often beneficial to moose so the effects may create new habitat. The cumulative residual effect of habitat loss on moose is considered **not significant** (minor) both with and without the Harper Creek Project.

16.8.6 Confidence and Uncertainty in Determination of Significance

Confidence, which can also be understood as the level of uncertainty associated with the assessment, is a measure of how well the residual cumulative effects are understood and the confidence associated with the baseline data, modelling techniques used, assumptions made, effectiveness of mitigation, and resulting predictions/knowledge of past projects, present projects, foreseeable future projects, and activities.

Confidence is based on an evaluation of the scientific certainty in the review of data, relevant literature, and professional opinion. Definitions of the confidence descriptors can be found in Table 16.7-1. Confidence in the significance of cumulative effects for the five wildlife VCs is described below. A summary of cumulative residual effects and their characterization criteria, significance determination, likelihood, and confidence evaluations is presented in Table 16.8-8.

<u>Western Toad</u>

It is difficult to predict mortality effects to any given VC. The amount of mortality due to construction activities such as vegetation clearing and vehicles will vary depending on the time of year, the population, the life history stage, and effectiveness of mitigation implemented. Adult western toads are not at as great a risk of mortality as toadlets and tadpoles. There remain a number of unknown external variables (e.g., effectiveness of mitigation, seasonal timing of construction activities for other projects) and data for the RSA are incomplete. While results may vary, predictions that mortality may occur are relatively confident; therefore, the level of confidence for the cumulative effects assessment of western toad mortality is **moderate**.

<u>Olive-sided Flycatcher</u>

The Olive-sided Flycatcher species-habitat model is moderately accurate due to changes to the structure of forests since the mapping was completed; therefore confidence in the predicted area of habitat potentially impacted by noise is also **moderate**. The impact of noise on songbirds suggests that flycatchers will be displaced but no specific information is available for the species. Flycatchers prefer disturbed habitats so it is possible they are more tolerant of noise than other species.

Table 16.8-8. Summary of Key Cumulative Effects, Mitigation, Cumulative Residual Effects Characterization Criteria, Likelihood, Significance, and Confidence

Key Cumulative Effect	Regional Mitigation Measures	Summary of Cumulative Residual Effects Characterization Criteria *(Magnitude, Geographic Extent, Duration, Frequency, Reversibility, Resiliency)*	Likelihood *(High, Moderate, Low)*	Significance of Adverse Cumulative Residual Effects		Confidence *(High, Moderate, Low)*
				Magnitude *(High, Moderate, Low)*	Rating *(Not Significant; Significant)*	
Western Toad road mortality	FRPA Riparian buffers, Project and road reclamation	Mortality is expected to be medium magnitude. This effect is predicted to be pre-existing and is occurring/will occur regardless of the Harper Creek Project. The effect is predicted to occur throughout the RSA (regional), and occur sporadically during the breeding season. It is partially reversible if projects and roads are reclaimed and will extend into the future while existing roads remain active. Toad resilience is considered neutral.	*Moderate*	*Low*	*Not significant*	*Moderate*
Olive-sided Flycatcher	Project closures, road closures/reclamation	A low magnitude and local effect is expected to occur continuously over the long term. Effects may be reversible and resilience is neutral.	Low	Low	Not Significant	Moderate
Grizzly Bear	GBPU management planning, Protected areas	A pre-existing high magnitude, regional cumulative effect has occurred in the RSA. This effect is predicted to be pre-existing and is occurring/will occur regardless of the Harper Creek Project. The effect occurs sporadically and frequency future. It is considered partially reversible if some activities cease and areas reclaimed in the RSA, and grizzly bears have neutral resiliency.	High	Moderate	Not Significant	High

(continued)

Table 16.8-8. Summary of Key Cumulative Effects, Mitigation, Cumulative Residual Effects Characterization Criteria, Likelihood, Significance, and Confidence (completed)

Key Cumulative Effect	Regional Mitigation Measures	Summary of Cumulative Residual Effects Characterization Criteria *(Magnitude, Geographic Extent, Duration, Frequency, Reversibility, Resiliency)*	Likelihood *(High, Moderate, Low)*	Significance of Adverse Cumulative Residual Effects		Confidence *(High, Moderate, Low)*
				Magnitude *(High, Moderate, Low)*	Rating *(Not Significant; Significant)*	
Moose	CMWR management planning	A low magnitude regional cumulative effect of habitat loss is expected, and will occur sporadically and long term. The effect can be partially reversed with reclamation/road closures, etc. Moose have high resiliency.	Low	Low	Not Significant	High

Grizzly Bear

Loss of effectiveness of habitat for grizzly bears due to human influences is well documented and road density thresholds are commonly used to assess potential occupancy of suitable habitat by grizzly bears. Supporting data is consistent with expectations that grizzly bears rarely use the area. Confidence for the assessment of grizzly bear habitat loss is considered **high**, as there is a good understanding of the cause-effect relationship, as the effect is pre-existing.

Moose

Moose are relatively well understood with regards to habitat preferences and limiting factors. Management regimes are applied within CMWR to maintain populations. Therefore the level of certainty associated with the cumulative effects assessment of moose habitat loss is **high.**

16.9 Conclusions for Wildlife

The scoping process identified 14 wildlife VCs: western toad, Barn Swallow, Common Nighthawk, Harlequin Duck, Olive-sided Flycatcher, Bald Eagle, Northern Goshawk, bats, fisher, grizzly bear, moose, mountain caribou, mule deer and wolverine. Potential effects included: habitat alteration, disturbance and displacement, and mortality. After mitigation, residual effects were predicted for: western toad, Harlequin Ducks, Olive-sided Flycatcher, grizzly bear, and moose. Through implementation of mitigation programs, no significant residual effects are expected to occur as a result of the Project.

An assessment of cumulative effects was also conducted that evaluated the residual effects of the Project for interactions with effects from past, present and reasonably foreseeable future projects and activities within the RSA. Each of the five wildlife VCs expected to be subject to residual Project effects (western toads, Harlequin Ducks, Olive-sided Flycatcher, grizzly bear, and moose) were also found to have potential interactions with other projects or activities in the RSA, primarily as a result of historic and ongoing land use practices and existing projects in the RSA. No significant cumulative residual effects were predicted for any of the VCs.

A summary of residual and cumulative effects identified in this assessment is presented in Table 16.9-1.

Table 16.9-1. Summary of Project and Cumulative Residual Effects, Mitigation, and Significance for Wildlife

Key Residual Effects	Project Phase	Mitigation Measures	Significance of Residual Effects	
			Project	Cumulative
Western toad				
Habitat Alteration and Loss	Construction and Operations	Wetland reclamation and creation.	Not significant (moderate)	Not significant (minor)
Mortality	Construction and Operations	Speed limits, adaptive management along roads, avoid breeding sites during clearing activities.	Not significant (minor)	N/A*
Harlequin Duck				
Habitat Alteration: Contaminants	Operation, Closure and Post-Closure	Selenium Management Plan	Not significant (minor)	N/A
Olive-sided Flycatcher				
Disturbance and Displacement	Construction and Operations	Noise Management Plan	Not significant (minor)	Not significant (minor)
Grizzly Bear				
Habitat Alteration and Loss	Construction and Operations	Re-vegetation, Project Site reclamation.	Not significant (minor)	Not significant (moderate)
Moose				
Habitat Alteration and Loss	Construction and Operations	Re-vegetation, Project Site reclamation.	Not significant (minor)	Not significant (minor)

**N/A indicates the cumulative effect was not considered residual.*

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