RED MOUNTAIN UNDERGROUND GOLD PROJECT
VOLUME 3 | CHAPTER 16
WILDLIFE AND WILDLIFE HABITAT EFFECTS ASSESSMENT

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16.1 Introduction

This chapter presents an assessment of the potential Project-related and cumulative effects of the proposed Red Mountain Underground Gold Project (the Project) on Wildlife and Wildlife Habitat. Individual wildlife species were selected as valued components (VCs) for the Project because of i) the potential for interactions with the Project due to spatial or temporal overlap; ii) legislative or regulatory requirements (e.g., species at risk); iii) the outcome of consultation with the public, Aboriginal Groups, government agencies, and other stakeholders, and iv) their importance in contributing to regional biodiversity. The selection of individual wildlife species as VCs focused the effects assessment since it was not practical to assess the potential effects of the Project on all wildlife species that occur or may occur within the assessment area. This effects assessment identifies and characterizes potential interactions between the Project and Wildlife and Wildlife Habitat and describes the mitigation measures and protection plans that IDM Mining Ltd. (IDM) will implement to manage, mitigate, and/or monitor Project-related effects on Wildlife and Wildlife Habitat.

This chapter is structured so that reviewers can find the information required to review the assessment of potential Project-related and cumulative effects of the Project on Wildlife and Wildlife Habitat, beginning with a review of the existing regulations, policies, and Best Management Practices (BMPs) within which this assessment was developed and determinations of significance were made.

The Wildlife and Wildlife Habitat Effects Assessment has linkages to, and has been informed by, the assessment of other IC/VC pathways. These include of Air Quality (Chapter 7), Noise (Chapter 8), Landforms and Natural Landscapes (Chapter 9), Surface Water Quality (Chapter 13), Vegetation and Ecosystems (Chapter 15), Fish, and Country Foods.

The results of this assessment have also been carried forward to inform the Health Effects Assessment (Volume 3, Chapter 22) and used in the development of the Screening Level Ecological Risk Assessment (Volume 8, Appendix 22-B). The results of this assessment have also informed the assessment of potential Project effects on Nisga’a Nation Treaty interests (Chapter 27), and on Tsetsaut Skii km Lax Ha’s and Métis Nation BC’s Aboriginal Interests and Current Use of Lands and Resources for Traditional Purposes (Chapters 20.10, 25, and 26).

Figure 16.1-1, Figure 16.1-2, and Figure 16.1-3 illustrate the entire Project footprint and the established disturbance limits for the Mine Site (location of Upper and Lower Portals) and for Bromley Humps (location of Process Plant and Tailings Management Facility (TMF)).

The results of the Wildlife and Wildlife Habitat Effects Assessment show that there will be no effects to Wildlife and Wildlife Habtiat outside of Canada.

Figure 16.1-1: Project Overview

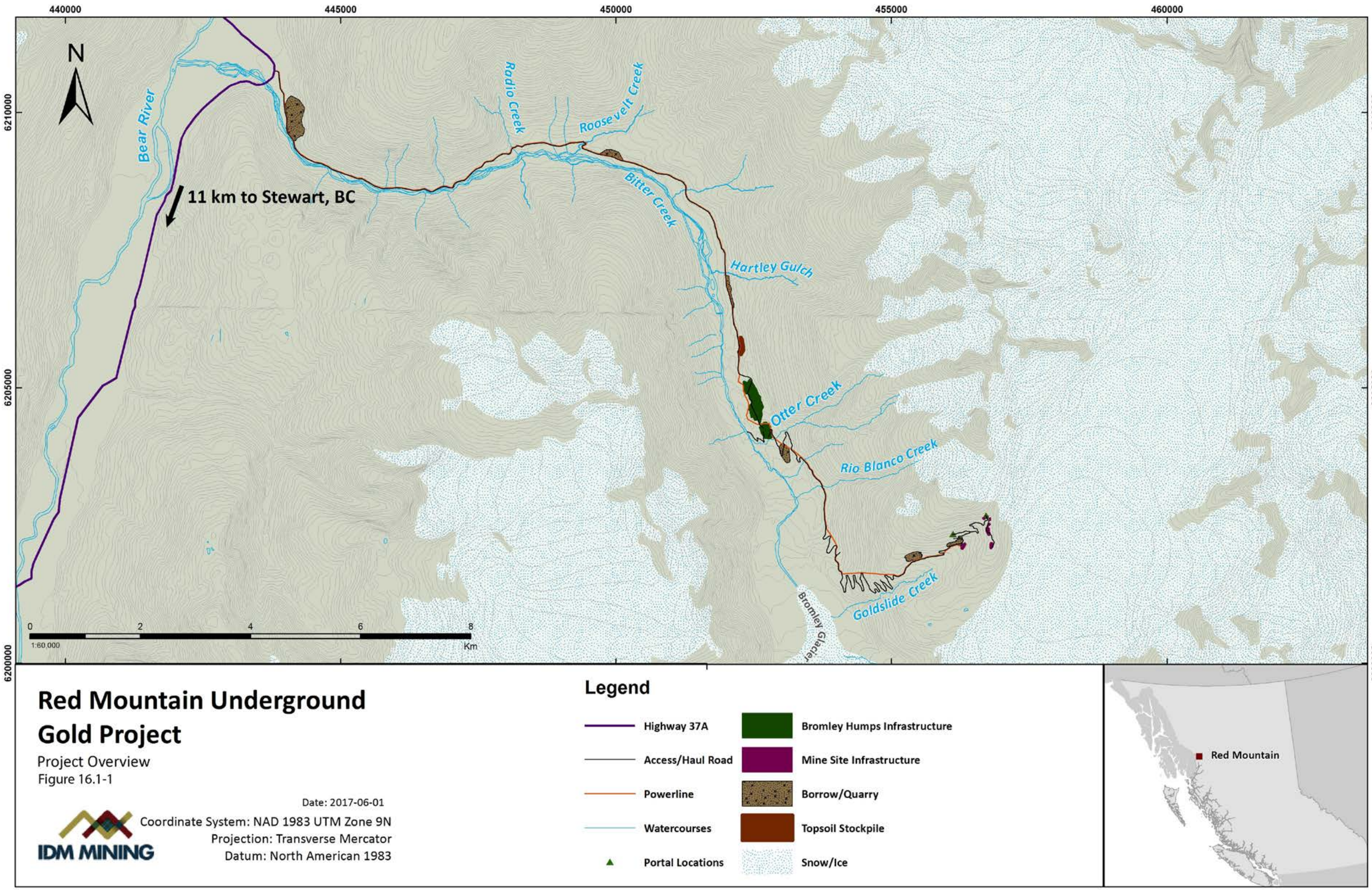


Figure 16.1-2: Project Footprint – Bromley Humps

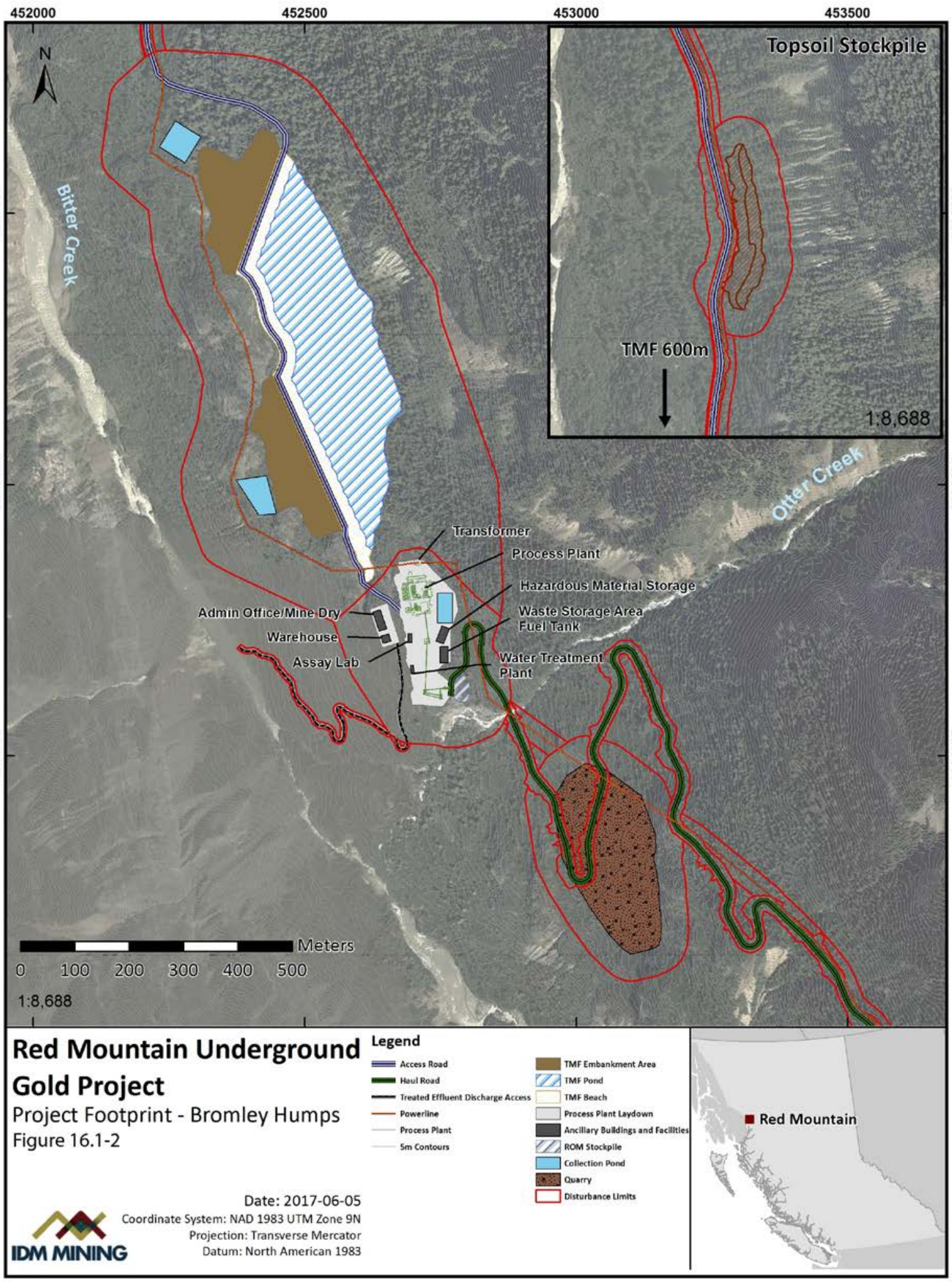
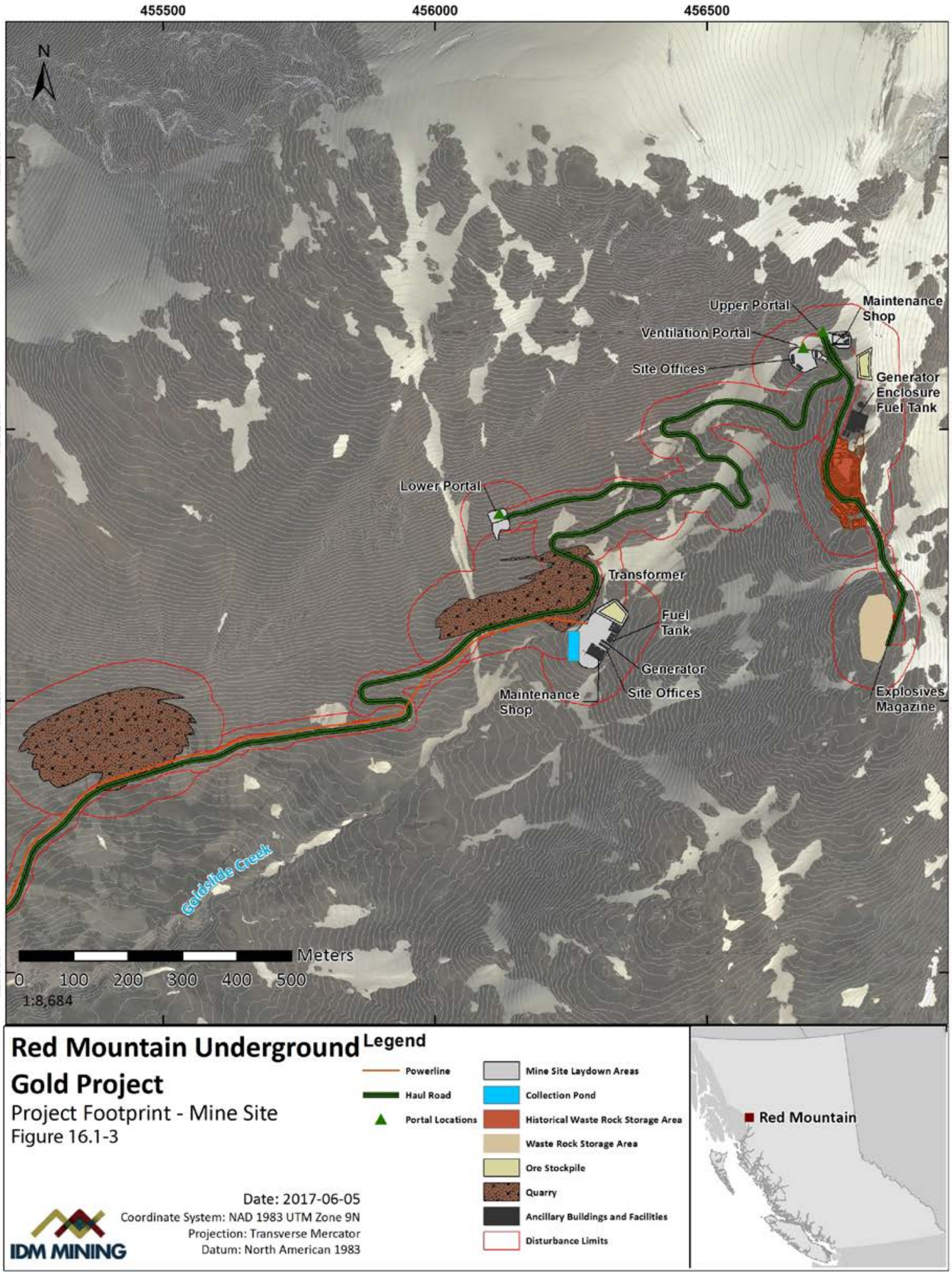


Figure 16.1-3: Project Footprint – Mine Site



16.2 Regulatory and Policy Setting

This effects assessment considered applicable federal and provincial legislation, regulations, strategies, guidelines, plans, and BMPs that relate to wildlife, including those provided by Aboriginal Groups. Applicable recommendations in provincial land use plans and designations were also considered.

The Application Information Requirements (AIR) for the Project, approved by the British Columbia (BC) Environmental Assessment Office (EAO) in March 2017, outlines the requirements of the Wildlife and Wildlife Habitat Effects Assessment to meet both the provincial and federal environmental assessment (EA) requirements under the *BC Environmental Assessment Act* (2002) and *Canadian Environmental Assessment Act* (2012), respectively.

16.2.1 Federal

The Pacific/Yukon Region of Environment and Climate Change Canada (ECCC) administers or shares responsibility for multiple Acts addressing legislation directly or indirectly related to wildlife.

In addition to federal legislation, numerous documents provide guidance related to wildlife (Table 16.2-1). For example, the *Environmental Assessment Best Practice Guide for Wildlife at Risk in Canada* (EC 2004) provides guidance for project proponents and other individuals involved in preparing environmental assessments. It outlines consideration for wildlife species at risk in Canada, best practice guidelines, and implications of the *Species at Risk Act* (SARA) for environmental assessment. The Canadian Biodiversity Strategy (Government of Canada 1995) and the Federal Policy on Wetland Conservation (Government of Canada 1991) provide Canada's strategy on biodiversity and policy on wetlands.

Table 16.2-1: Summary of Applicable Federal Legislation for Wildlife

Name	Year	Description
Canada Wildlife Act (CWA)	1985	The CWA protects and conserves wildlife through the creation and management of National Wildlife Areas (NWAs, ECCC 2016a). NWAs are intended to preserve critical habitats for migratory birds and other wildlife species. The Wildlife Area Regulations prohibits activities that could be harmful to wildlife and their habitats unless an activity is authorized under a permit. There are no NWAs within the region surrounding the Project (ECCC 2016f); therefore, the CWA is not applicable to the Project.

Name	Year	Description
Migratory Birds Convention Act (MBCA)	1994	The MBCA protects and conserves migratory birds (as individuals and populations), their eggs, and their nests in Canada through the implementation of the Migratory Birds Regulations and the Migratory Birds Sanctuary Regulations (ECCC 2016e). As per the MBCA, removal of migratory birds, their eggs, or nests from a site is only permissible if the migratory birds are causing or may cause damage to property and equipment (subject to permitting). Deposit of harmful substances to birds in areas or waters frequently visited by migratory birds is prohibited. The Migratory Birds Regulations are applicable to the Project. The Migratory Birds Sanctuary Regulations are not applicable to the Project as there are no Migratory Bird Sanctuaries within the region surrounding the Project (ECCC 2016f).
Canadian Environmental Protection Act (CEPA)	1999	The CEPA aims to prevent, control, and manage pollutants, wastes, and other toxic substances for the protection of the environment and human health to contribute to sustainable development (ECCC 2017). The CEPA is applicable to the Project as IDM will be responsible for managing Project-related pollutants, wastes, and other toxic substances for the protection of the environment and human health.
Species at Risk Act (SARA)	2002	The SARA provides for the legal protection of plant and wildlife species to conserve their biological diversity and prevent extirpation or extinction (ECCC 2016g). Under SARA, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) identifies and assesses plant and wildlife species considered at risk, which may then qualify for legal protection and recovery under SARA. Once listed under SARA, species management or recovery plans are legal requirements to secure the necessary actions for species recovery and management. Recovery strategies and management plans have been developed or proposed for these SARA-listed wildlife species that could occur within the Project area: • Management Plan for the western toad (*Anaxyrus boreas*) in Canada [Proposed] (ECCC 2016d) • Recovery Strategy for the common nighthawk (*Chordeiles minor*) in Canada (EC 2016a) • Recovery Strategy for little brown myotis (*Myotis lucifugus*), northern myotis (*Myotis septentrionalis*), and tri-colored bat (*Perimyotis subflavus*) in Canada [Proposed] (EC 2015) • Recovery Strategy for the marbled murrelet (*Brachyramphus marmoratus*) in Canada (EC 2014a) • Recovery Strategy for the olive-sided flycatcher (*Contopus cooperi*) in Canada (EC 2016b) Within these recovery strategies, critical habitat was defined for marbled murrelet and one polygon of mapped critical habitat lies within the Project local study area (LSA) for Wildlife. That polygon was surveyed and confirmed as not having the suitable habitat characteristics for marbled murrelet. Any site where little brown myotis or northern myotis has been observed hibernating during the winter at least once since 1995 is identified as critical habitat. To date surveys for hibernation sites have not been conducted within the Project regional study area (RSA) for Wildlife and no critical habitat has been identified. A complete list of the Wildlife VCs and applicable federal listings for species at risk are identified in following sections.

16.2.2 Provincial

The British Columbia Ministry of Forests, Lands and Natural Resource Operations (FLNRO) is responsible for managing wildlife and wildlife habitat within the region surrounding the Project (Table 16.2-2). The Project is within the Skeena Region (Region 6).

Table 16.2-2: Summary of Applicable Provincial Legislation for Wildlife

Name	Year	Description
Ecological Reserve Act (ERA)	1996	The ERA provides for the establishment and administration of ecological reserves, which may be created to protect and preserve species at risk and their habitats (BC Parks 2017). There are no ecological reserves within the Project RSA for Wildlife (Data BC 2017a).
Land Act	1996	Crown land is partly managed under the authority of the *Land Act*, which is the primary legislation the Province of British Columbia uses to convey land to the public for community, business, or industrial use (Province of BC 2017a). Sustainable management of Crown land and natural resources is guided in part by the *Land Act* and associated Land Use Objectives Regulation in addition to land use plans, which work to protect species at risk and their habitats within certain geographical regions (Province of BC 2017e). Two land use plans overlap the Project area: the Nass South Sustainable Resource Management Plan (NSSRMP; FLNRO 2012c) and the North Coast Land and Resource Management Plan (LRMP; BC MSRM 2005). These land use plans include resource management objectives for wildlife and wildlife habitat that are applicable to the Project.
Mines Act	1996	The *Mines Act* and accompanying Health, Safety and Reclamation Code for Mines in British Columbia include provisions for the protection of the land and watercourses by minimizing the environmental risks associated with mining activities, in addition to reclamation requirements for disturbed areas (Province of BC 2017d).
Wildlife Act	1996	The *Wildlife Act* defines wildlife as all native (and some non-native) amphibians, birds, mammals, and reptiles that live in British Columbia (FLNRO 2017b). The *Wildlife Act* provides for the protection, conservation, and management of wildlife populations and wildlife habitats within British Columbia. Under Section 34 of the Act, it is an offence to possess, take, injure, molest, or destroy a bird, its egg(s), or a nest that is occupied by a bird or its egg(s). The nests of certain species[1] are protected year round. Wildlife species can be legally designated as endangered, threatened, or special concern under the Act, which enables penalties for killing or harming wildlife, or the establishment of Critical Wildlife Habitats in Wildlife Management Areas.
Environmental Assessment Act (EAA)	2002	The BCEAA provides a mechanism for the Province of British Columbia to review all major projects proposed in the province to assess for any potentially adverse environmental, economic, social, heritage, or health effects (Province of BC 2017b). The assessment process ensures that the issues and concerns of the public, Aboriginal Groups, government agencies, and other stakeholders are considered. The goal of the Act is to ensure environmental, economic, and social sustainability.

Name	Year	Description
Forest and Range Practices Act (FRPA)	2002	The FRPA outlines standards and requirements for how forest and range practices and natural resource activities should be conducted on Crown land in British Columbia in a manner that ensures protection of natural resources, including wildlife (Province of BC 2017c). Mechanisms under the FRPA that ensure protection of ungulates and species at risk include Ungulate Winter Ranges (UWRs) and Wildlife Habitat Areas (WHAs). An UWR is an area of habitat that is critical to meeting an ungulate species' winter habitat requirements (BC MOE 2017b). A WHA is an area of habitat that is critical to meeting the habitat requirements of an Identified Wildlife species (BC MOE 2017c). Identified Wildlife includes species legally designated as endangered, threatened, or special concern under the *Wildlife Act* (BC MOE 2017a). Identified Wildlife also includes species considered important to a region of British Columbia, species that rely on habitats not otherwise protected under the FRPA, or species that may be adversely affected by forest and range practices. Within a WHA, activities are managed to minimize any adverse effects to Identified Wildlife (BC MOE 2017c). The Project RSA overlaps an approved WHA for grizzly bear (Data BC 2017f) and three approved UWRs for mountain goat or moose (Data BC 2017e). The Project LSA overlaps with one approved UWR for mountain goat.
Environmental Management Act (EMA)	2003	The EMA regulates pollution, hazardous waste, contaminated site remediation, and the discharge of municipal and industrial waste to the environment while ensuring the protection of human health and the environment (Province of BC 2017f). The EMA is applicable to the Project as IDM will be responsible for managing Project-related pollution, hazardous waste, contaminated sites, and the discharge of industrial waste to the environment while ensuring the protection of the environment (including wildlife) and human health.

[1] Eagle, peregrine falcon (*Falco peregrinus*), gyrfalcon (*Falco rusticolus*), osprey (*Pandion haliaetus*), heron, or burrowing owl (*Athene cunicularia*).

Additional to the provincial legislation, there are multiple provincial strategies, plans, guidelines, and BMPs that relate to Wildlife and Wildlife Habitat (Table 16.2-3). For example, there are management and recovery plans/strategies for specific wildlife species (e.g., Management Plan for the Mountain Goat in British Columbia [MGMT 2010], Recovery Strategy for the northern goshawk *laingi* subspecies in British Columbia [NGRT 2008]). There are also specific management guidelines and BMPs for wildlife (e.g., Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia [BC MOE 2013a], Best Management Practices for Bats in British Columbia [BC MOE 2016]). Furthermore, the Avian Power Line Interaction Committee based in the United States has developed suggested practices for mitigating the potential adverse effects of power lines on bird species (Suggested Practices for Avian Protection On Power Lines: The State of the Art in 2006; APLIC 2006). These documents were considered when identifying the potential effects of the Project, developing appropriate mitigation measures, and characterizing residual effects.

Table 16.2-3: Summary of Applicable Provincial Strategies, Guidelines, Plans, and Best Management Practices for Wildlife

Name	Year	Type	Description
Identified Wildlife Management Strategy – Accounts and Measures for Managing Identified Wildlife	2004	Management Strategy	The Accounts and Measures for Managing Identified Wildlife summarize the status, life history, distribution, and habitat requirements of Identified Wildlife; they also outline specific guidelines for habitat conservation and management (BC MWLAP 2004b).
Identified Wildlife Management Strategy – Procedures for Managing Identified Wildlife	2004	Management Strategy	The Procedures for Managing Identified Wildlife describe the procedures for establishing, modifying, and rescinding a WHA, and for implementing strategic and landscape level planning recommendations (BC MWLAP 2004c).
Best Management Practices for Amphibians and Reptiles in Urban and Rural Environments in British Columbia	2004	Best Management Practices	The purpose of these BMPs are to provide information on the potential effects of different land development activities on amphibians/reptiles and their habitats, and guidance on how to minimize these potential effects to maintain the viability of native amphibian and reptile populations (BC MWLAP 2004a).
Recovery Strategy for the Northern Goshawk, *laingi* subspecies (*Accipiter gentilis laingi*) in British Columbia	2008	Recovery Strategy	This recovery strategy outlines the best available scientific information regarding what is required to achieve recovery of the northern goshawk *laingi* subspecies. The recovery strategy also identifies recovery goals, objectives, and recommended actions to achieve recovery (NGRT 2008).
British Columbia Conservation Framework	2009	Framework	The Conservation Framework works to prioritize species and ecosystems of conservation concern for management action based on global and provincial status, population trends, threats, stewardship responsibilities, and feasibility of recovery. The Conservation Framework also provides guidance on the most appropriate and effective conservation and management actions needed to achieve recovery (BC MOE 2009).
Management Plan for the Mountain Goat (*Oreamnos americanus*) in British Columbia	2010	Management Plan	This management plan identifies conservation actions and land use measures that are necessary to ensure mountain goat do not become threatened or endangered in British Columbia. The management plan summaries the best available scientific information regarding the biology of mountain goat and any known threats to the species. The management plan also identifies goals, objectives, and recommended actions to achieve conservation (MGMT 2010).

Name	Year	Type	Description
Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia	2013	Guidelines	The purpose of these guidelines is to help maintain raptor populations and their habitats during urban and rural land development in British Columbia (BC MOE 2013a). The document is a companion document to Develop With Care 2014: Environmental Guidelines for Urban and Rural Land Development in British Columbia.
Management Plan for the northern goshawk, *laingi* subspecies (*Accipiter gentilis laingi*) in British Columbia	2013	Management Plan	The management plan is intended to support the ongoing conservation and recovery efforts for the northern goshawk *laingi* subspecies as detailed in the 2008 British Columbia Recovery Strategy, while still making allowances for continued resource development opportunities (FLNRO 2013).
Recovery Plan for the Western Screech-owl, *kennicottii* subspecies (*Megascops kennicottii kennicottii*) in British Columbia	2013	Recovery Plan	This recovery plan outlines the best available scientific information regarding what is required to achieve recovery of the western screech-owl *kennicottii* subspecies. The recovery plan also identifies recovery goals, objectives, and strategic actions to achieve recovery (BC MOE 2013b).
A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia – Interim Guidance	2014	Guidelines	These guidelines provide direction for considering and mitigating threats to wildlife and wildlife habitat in the North Area (i.e., Peace, Omineca, and Skeena regions) during industrial activities (FLNRO 2014).
Develop With Care 2014: Environmental Guidelines for Urban and Rural Land Development in British Columbia: Section 4 Environmentally Valuable Resources	2014	Guidelines	The purpose of these guidelines is to province-wide direction for maintaining environmentally valuable resource during urban and rural land development in British Columbia. Environmentally valuable resources include species, features, or locations that enhance the biodiversity of an area; these may include common or rare species or habitats (BC MOE 2014a).
Guidelines for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia	2014	Guidelines	The purpose of these guidelines is to help maintain amphibian and reptile populations and their habitats during urban and rural land development in British Columbia (BC MOE 2014b). The document is a companion document to Develop With Care 2014: Environmental Guidelines for Urban and Rural Land Development in British Columbia.
Management Plan for the Western Toad (*Anaxyrus boreas*) in British Columbia	2014	Management Plan	This management plan identifies conservation actions and land use measures that are necessary to ensure western toad do not become threatened or endangered in British Columbia. The management plan summaries the best available scientific information regarding the biology of western toad and any known threats to the species. The management plan also identifies goals, objectives, and recommended actions to achieve conservation (PWTWG 2014).

Name	Year	Type	Description
Policy for Mitigating Impacts on Environmental Values	2014	Policy	The purpose of this policy is to improve the quality, transparency, and consistency of information to support provincial staff, decision makers, and proponents when there is an identified need for environmental mitigation under existing legislation. The policy applies to the identification of VCs, the assessment of potential effects, the development of mitigation measures, and the preparation of mitigation plans (BC MOE 2014c).
Procedures for Mitigating Impacts on Environmental Values	2014	Procedures	These procedures outline recommended guidance and approaches for implementing the policy described above. The procedures describe how to select VCs, conduct environmental assessments, apply the mitigation hierarchy, and complete mitigation and monitoring plans (BC MOE 2014d).
Protecting Vulnerable Species: A Five-Year Plan for Species at Risk in British Columbia	2014	Plan	This plan outlines high-level strategic actions that work to balance economic, environmental, and social priorities in British Columbia while improving the management of species of risk (Province of BC 2014).
Provincial Framework for Moose Management in British Columbia	2015	Framework	The purpose of this framework is to provide guidance on moose management in British Columbia. In particular, the framework focuses on the preparation of regional moose action plans and the establishment of a scientific foundation for moose harvest management decisions (FLNRO 2015).
Science-Based Guidelines for Managing Northern Goshawk Breeding Areas in Coastal British Columbia	2015	Guidelines	These guidelines provide direction for northern goshawk habitat management in coastal British Columbia (McClaren et al. 2015).
Best Management Practices for Amphibian and Reptile Salvages in British Columbia	2016	Best Management Practices	The purpose of these BMPs are to provide guidance on how to plan and implement amphibian and reptile salvages while minimizing adverse effects to the translocated and recipient amphibian and/or reptile populations (FLNRO 2016a).
Best Management Practices for Bats in British Columbia	2016	Best Management Practices	The purpose of these BMPs are to provide information on the potential effects of different natural resource development activities on bats and their habitats, and guidance on how to minimize these potential effects (BC MOE 2016).
A Strategy to Help Restore Moose Populations in British Columbia	2016	Strategy	This strategy provides recommendations to restore seriously depleted moose populations and increase moose populations in general across BC (Gorley 2016).

The Project LSA and most of the RSA overlap portions of the Nass South SRMP (NSSRMP; FLNRO 2012c). The southern portion of the Project RSA also overlaps the North Coast LRMP (BC MSRM 2005). The NSSRMP and North Coast LRMP describe resource management objectives for Wildlife and Wildlife Habitat, including mountain goat, grizzly bear, moose, furbearers, marbled murrelet, northern goshawk, and other general wildlife. Wildlife-related management goals of the NSSRMP and North Coast LRMP that are relevant to this assessment are described in Table 16.2-4. These management goals were considered in the mitigation measures identified in Section 16.6.1.

Table 16.2-4: Wildlife Management Goals and Objectives Established by Land Use Plans

Wildlife Resource	Goals	Objectives
Nass South Sustainable Resource Management Plan		
Mountain goat	Manage winter range to help ensure a healthy population	Minimize adverse disturbance to goats within mountain goat winter range
	Avoid disturbance and displacement during vulnerable periods	Minimize adverse disturbance to mountain goat winter range from helicopter logging
	Minimize pressure on the population from legal and illegal harvest through human access management	Minimize the number of roads within 500 metres (m) of mountain goat winter range and 1,000 m of canyon dwelling goat winter range
Grizzly bear	Provide adequate habitat to ensure a healthy population	Preserve the highest value grizzly bear habitat Maintain the quality and effectiveness of grizzly bear foraging habitat Minimize human-bear conflicts Minimize long-term displacement of grizzly bears from industrial access development
Moose	Manage winter range to help ensure a healthy population	Maintain, enhance or restore winter habitats
	Minimize pressure on the population from legal and illegal harvest through human access management	Minimize mortality and disturbance to within and adjacent to winter ranges through access management
Furbearers	Maintain high value habitat for identified species to help ensure a healthy population	Minimize effect to known high value fisher and wolverine habitat
Northern goshawk	Maintain a viable population within the plan area	Maintain nesting and post-fledging habitat a known goshawk nest areas, to support continued use and reproduction in those areas Maintain foraging habitat around known known goshawk nest and post-fledging areas
General	Protect special habitats for general wildlife	Maintain effectiveness of riparian habitats adjacent to wetlands

Wildlife Resource	Goals	Objectives
North Coast Land and Resource Management Plan		
Mountain goat	To manage and sustain mountain goat winter range and optimum populations at a low risk by maintaining habitat quality, quantity and distribution throughout their natural range	Maintain functional and structural attributes of goat winter ranges wherever they occur in the landscape Maintain habitat suitability of winter range by minimizing disturbance and mortality risk to mountain goats Minimize road-induced displacement and mortality risk within or adjacent to UWR
Grizzly bear	To maintain the abundance, distribution and genetic diversity of populations in each Grizzly Bear Population Unit	To maintain the diversity and abundance of grizzly bears in the North Coast LRMP area
	Minimize the risk of bear displacement and mortality as a result of human activities, including roaded and air access	To minimize mortality risk to bears related to motorized road access at the watershed scale To minimize road-induced displacement and mortality risk of bears within or adjacent to critical habitats
	Maintain the quality and quantity of bear habitat across multiple scales	To maintain landscape level forage supply by BGC variant on a continual basis (spatially and temporally) To maintain adequate forage within managed forest stands by maintaining productive understories To maintain the integrity of land linkage amongst critical grizzly bear habitats, including functional visual (security) and resting (bedding) cover
	Management of human activities, including bear viewing, so that bear habituation does not exceed low to moderate levels	To minimize effects to bears from water- and air-based commercial and non-commercial wildlife viewing To minimize effects to bears from land-based commercial and non-commercial wildlife viewing To minimize displacement and habituation of bears due to commercial recreation activities including land-based bear viewing To prevent bear mortality resulting from negative bear-human interactions (e.g., bears conditioned to human attractants (garbage, pet food, offal)
	Grizzly bear management areas	Regulation of hunting levels and providing benchmark areas where hunting bears is not permitted
	Minimize the potential for bear-human interaction	Minimizing potential for bear-human interaction by promoting the use of “bear awareness”
	Area-specific management	Maintain benchmark populations of grizzly bears within the Skeena-Nass Grizzly Bear Management Area
Moose	To maintain healthy and viable populations of moose at a low risk throughout their potential range	To minimize the potential for moose mortality in roaded areas in identified winter range To maintain the quality of snow interception and browse produced within identified moose winter range

Wildlife Resource	Goals	Objectives
Marbled murrelet	Maintain adequate nesting habitat to ensure viable populations of marbled murrelet across their present range within the plan area To have marbled murrelet down-listed from Threatened to Special Concern under the federal SARA	Maintain the quantity and quality of marbled murrelet nesting habitat across the plan area Maintain quantity and quality of optimal nesting habitat in core areas
Northern goshawk	To maintain adequate nesting and foraging habitat to ensure a viable population of northern goshawks across their present range within the plan area	To maintain all known goshawk nest areas and post-fledging areas with sufficient mature and old growth forest to allow continued occupancy and successful reproduction To maintain sufficient foraging habitat adjacent to nest areas to allow continued occupation of the breeding territory Undertake research and inventory to (a) identify the distribution, and habitat needs, of goshawks including identification of nest areas and post-fledging areas, and (b) characterize the taxonomy of the subspecies found in the plan area
Coarse filter biodiversity	Maintain the natural biodiversity of the North Coast LRMP area, including the full range of functional ecosystems, over time and at all scales	Identify and reserve key wildlife migration/movement corridors Designate and protect known critical wildlife habitat features vital to a variety of species

16.2.3 Nisga'a Lisims Government

The project is within the Nass Area and the Nass Wildlife Area, as set out in *Nisga'a Final Agreement* (NFA 1999). The NFA is a negotiated treaty between Nisga'a Nation, as represented by the Nisga'a Lisms Government (NLG), the Province of British Columbia, and the Government of Canada that sets out Nisga'a Nation's right to self-government and authority to manage lands and resources within the Nass Area, which includes Nisga'a Lands and the Nass Wildlife Area (NLG 2017b). The NFA and supporting acts, regulations, and management plans operate alongside Canadian federal laws and British Columbia provincial laws (NLG 2017b). The NFA sets out how to address conflicts or inconsistencies between Nisga'a laws and federal/provincial laws (NLG 2017b).

Under the NFA, Nisga'a citizens have the right to harvest migratory birds within the Nass Area year-round for domestic purposes. The Nass Area includes the entire Nass River watershed and encompasses approximately 27,000 square kilometres (km²) (NLG 2017a). Under the NFA, Nisga'a Nation, as represented by Nisga'a Lisims Government (NLG), has Treaty rights to the management and harvesting of fish, wildlife, and migratory birds within the Nass Wildlife Area and the larger Nass Area. The Nass Wildlife Area is a 16,101 km² area within the Nass Area that allows for specific Nisga'a allocations for designated wildlife species (i.e., mountain goat, grizzly bear, and moose; NLG 2017c). Hunting and trapping of designated and non-designated wildlife species within the Nass Wildlife Area are managed under *Nisg̲a'a Fisheries and Wildlife Act* (2012) and associated regulations (e.g., Nisga'a Wildlife Regulations 2003) in addition to the current Nisga'a Annual Wildlife Management Plan (NLG 2014).

The project is also within the asserted traditional territory of Tsetsaut Skii km Lax Ha (TSKLH) and is within an area where Métis Nation BC (MNBC) claims Aboritignal rights.

16.3 Scope of the Assessment

16.3.1 Information Sources

The following information sources were reviewed and used during issues scoping and the VC selection process:

- Project Description, dated September 2015, and Supplemental Project Information, dated March 2016;
- Federal and provincial regulatory guidance documents (see Section 16.2);
- Publicly available reports and databases;
- Background technical reports;
- Baseline studies;
- Professional experience;
- Working Group meetings and discussions;
- Consultation with Aboriginal Groups;
- Meetings and discussions with interested stakeholders; and
- Feedback from public consultation efforts led by IDM and EAO.

As outlined in Chapter 6 (Effects Assessment Methodology), IDM has not conducted primary traditional use or traditional ecological knowledge (TEK) surveys in support of the Project due to the preferences of Nisga'a Nation, as represented by NLG, and EAO's and the Agency's direction for comparatively low levels of engagement with the other Aboriginal Groups potentially affected by the Project. IDM has committed to using TEK where that information is publicly available. As no TEK relevant to this effects assessment was publicly available at the time of writing, no TEK has been incorporated.

16.3.2 Input from Consultation

IDM is committed to open and honest dialogue with regulators, Aboriginal Groups, community members, stakeholders, and the public.

IDM conducted consultation with regulators and Aboriginal Groups through the Working Group co-led by EAO and the Agency. Where more detailed and technical discussions were warranted, IDM and Working Group members, including sometimes NLG representatives, held topic-focused discussions, the results of which were brought back to EAO and the Working Group as a whole.

Further consultation with Aboriginal Groups, community members, stakeholders, and the public has been conducted as outlined by the Section 11 Order and EIS Guidelines issued for the Project. More information on IDM's consultation efforts with Aboriginal Groups, community members, stakeholders, and the public can be found in Chapter 3 (Information Distribution and Consultation Overview), Part C (Aboriginal Consultation), Part D (Public Consultation), and Appendices 27-A (Aboriginal Consultation Report) and 28-A (Public Consultation Report. A record of the Working Group's comments and IDM's responses can be found in the comment-tracking table maintained by EAO.

Scoping of and selection of candidate Wildlife VCs were based primarily on consultation with NLG and provincial and federal regulatory agencies, and further refined during review of the draft Application Information Requirements (dAIR). Review and feedback during the dAIR process occurred between June 2016 and March 2017. Comments regarding Wildlife VCs provided through the consultation process and responses by IDM are summarized in Table 16.3-1.

Table 16.3-1: Summary of Consultation on Wildlife VCs

Wildlife VC	Feedback By		Consultation Feedback	Response
	NLG	G		
Mountain goat	X		Important to NLG due to Nisga'a Nation's Treaty rights to hunt in the Nass Wildlife Area. NLG requested that mountain goat baseline data be strengthened by: • Conducting ground-based observation surveys of mountain goats throughout the year, including spring kidding, summering, fall rutting, and wintering; • Confirming or rejecting mountain goat presence in the sub-alpine Project area; and • Investigating potential mountain goat use sites with trail cameras.	The following methods were included in baseline data collection for mountain goats: • Spotting scope visual observations; • Year-round data collection; • Mapping fine-scale features such as kidding or rutting as they are observed; and • Investigating suspected use areas with wildlife trail cameras.

Wildlife VC	Feedback By		Consultation Feedback	Response
	NLG	G		
Mountain goat	X		NLG recommended that the assessment of potential effects on mountain goats include a description of anticipated change to current distribution, abundance, and habitat, as well as an evaluation of the effects of predicted changes to the local population.	All of these factors have been considered in the Mountain Goat Effects Assessment.
Mountain goat	X		NLG requested that the assessment of potential effects on mountain goats include the management sub-unit spatial boundaries used by the Wildlife Committee to manage mountain goat in the Nass Wildlife Area.	IDM reviewed the mountain goat management unit spatial information for these blocks and concluded the RSA adequately captures the regional habitat and population.
Mountain goat	X		NLG requested that IDM conduct additional mountain goat surveys to assess seasonal habitat changes.	IDM conducted an additional late winter mountain goat survey in March 2017 and has planned to conduct further summer surveys. IDM provided NLG with the late winter mountain goat survey work plan prior to conducting the fieldwork.
Grizzly bear	X		Important to NLG due to Nisga'a Nation's Treaty rights to hunt in the Nass Wildlife Area.	Grizzly bear has been included as a Wildlife VC.
Moose	X		Important to NLG due to Nisga'a Nation's Treaty rights to hunt in the Nass Wildlife Area.	Moose has been included as a Wildlife VC.
Furbearers	X		Important to NLG due to Nisga'a Nation's Treaty rights to trap in the Nass Wildlife Area.	Furbearers have been included as a Wildlife VC.
Marten		X	ECCC recommended that marten be removed from the list of wildlife VCs because they have only been COSEWIC-assessed and/or SARA-listed in Newfoundland and Labrador, to date.	Acknowledged. Marten are being considered under the Furbearers VC.
Hoary marmot	X		Important as a food source for grizzly bear.	Hoary Marmots has been included as a Wildlife VC.
Bats	X	X	NLG and ECCC requested that bats be included in the wildlife effects assessment.	Bats (little brown myotis, northern myotis, and Keen's myotis) have been included in the wildlife effects assessment.

Wildlife VC	Feedback By		Consultation Feedback	Response
	NLG	G		
Migratory breeding birds		X	ECCC recommended that IDM not use federally listed or assessed species as indicator species in assessing potential effects to groups of migratory birds.	In recognition of ECCC comments, listed species have not been used as indicators to assess effects to migratory birds. Migratory Birds have been assessed as a separate VC.
Migratory birds species at risk		X	ECCC recommended that IDM not use federally listed or assessed species as indicator species in assessing potential effects to groups of migratory birds.	In recognition of ECCC comments, listed species have not been used as indicators to assess effects to migratory birds. Migratory Birds have been assessed as a separate VC.
Non-migratory game birds	X		Important to NLG due to Nisga'a Nation's Treaty rights to hunt in the Nass Wildlife Area.	Non-migratory game birds have been included as a Wildlife VC.
Amphibians		X	ECCC requested that Western Toad be included as a VC due to its status as listed as Special Concern on Schedule 1 of SARA.	Western toad has been included as a VC in the Wildlife Effects Assessment.
Amphibians	X		NLG informed IDM that Western Toad was not a species of importance.	Western toad has not been assessed as a species of importance to NLG.
General items		X	FLNRO requested that IDM consider the potential effects of light on wildlife.	The management of light effects to wildlife will be considered in the Wildlife Management Plan (Volume 5, Chapter 29)
General items	X		NLG raised concerns regarding the assessment endpoint of "self-sustaining" populations for wildlife, and mountain goats in particular.	IDM revised the wording for the assessment endpoints, for Fish- and Wildlife- related VCs to "the maintenance of ecological conditions that support populations relative to existing baseline".

NLG = Nisga'a Lisims Government;
G = Government - Provincial or federal agencies;
P/S = Public/Stakeholder - Local government, interest groups, tenure and license holders, members of the public;
TSKLH = Tsetsaut Skii km Lax Ha;
MNBC = Métis Nation BC;
O = Other

16.3.3 Valued Components, Measurement Indicators and Assessment Endpoints

Individual wildlife species were selected as VCs for the Project (Table 16.3-2) because of their potential for interactions with the Project due to spatial or temporal overlap with Project components or activities, legislative or regulatory requirements (e.g., species at risk), and the outcome of consultation with the public, Aboriginal Groups, government agencies, and stakeholders.

Table 16.3-2: Wildlife Valued Components

Valued Component	Species Name	BC[1]	COSEWIC[2]	SARA[3]
Mountain goat	*Oreamnos americanus*	Blue	-	-
Grizzly bear	*Ursus arctos*	Blue	Special Concern	-
Moose	*Alces americanus*	-	-	-
Furbearers				
American marten	*Martes americana*	-	-	-
Wolverine *luscus* subspecies	*Gulo gulo luscus*	Blue	Special Concern	-
Hoary marmot	*Marmota caligata*	-	-	-
Bats				
Keen's myotis	*Myotis keenii*	Blue	Data Deficient	Schedule 3 - Special Concern
Little brown myotis	*Myotis lucifugus*	-	Endangered	Schedule 1 - Endangered
Northern myotis	*Myotis septentrionalis*	Blue	Endangered	Schedule 1 - Endangered
Migratory breeding birds				
Habitat guilds	Not applicable	-	-	-
MacGillivray's warbler	*Geothlypis tolmiei*	-	-	-
Migratory bird species at risk				
Black swift	*Cypseloides niger*	Blue	Endangered	-
Common nighthawk	*Chordeiles minor*	-	Threatened	Schedule 1 - Threatened
Marbled murrelet	*Brachyramphus marmoratus*	Blue	Threatened	Schedule 1 - Threatened
Olive-sided flycatcher	*Contopus cooperi*	Blue	Threatened	Schedule 1 - Threatened
Raptors				
Northern goshawk *laingi* subspecies	*Accipiter gentilis laingi*	Red	Threatened	Schedule 1 - Threatened
Western screech-owl *kennicottii* subspecies	*Megascops kennicottii kennicottii*	Blue	Threatened	Schedule 1 - Special Concern

Valued Component	Species Name	BC[1]	COSEWIC[2]	SARA[3]
Non-migratory Game Birds				
Sooty grouse	*Dendragapus fuliginosus*	-	-	-
White-tailed ptarmigan	*Lagopus leucura*	-	-	-
Amphibians				
Western toad	*Anaxyrus boreas*	Blue	Special Concern	Schedule 1 - Special Concern

BC CDC 2017

[1] Provincially listed species at risk in British Columbia (Red = Endangered; Blue = Threatened).

[2] Federal species designated by COSEWIC in Canada for listing on Schedule 1 of the SARA.

[3] Federally listed species at risk in Canada (Schedule 1 = official list of wildlife species at risk; Schedule 3 = wildlife species waiting to be re-assessed for possible inclusion under Schedule 1).

During the VC selection process, species at risk potentially within the region were identified. Species with limited potential to interact with the Project, due to factors such as absence of habitat or location beyond expected range, were not included in the assessment as VCs. Table 16.3-4 provides a list of species at risk potentially occurring in the region, but not assessed for effects as a Valued Component.

Table 16.3-3: Species at risk not assessed for effects as a Valued Component

Species	COSEWIC	SARA	Potential to Occur within the LSA	Species detected during baseline[1]	Distribution (BNA, CDC, eBird)[2]	Threats (COSEWIC status reports)	Rationale – Species was not assessed for effects as a Valued Component
Peregrine falcon (*Falco peregrinus*)	Special Concern	Special Concern	Low to moderate	No	Poorly documented inland breeding range in BC; breeds east through Aleutians and Alaska Peninsula, then north along coastal Alaska; Winters from southern British Columbia (at least 49˚ N). No known occurrences in the regional study area.	DDT exposure, human interaction at nest sites, prey abundance	The species has a low chance of occurring and was not detected during wildlife surveys conducted for baseline studies, nor was it identified through working group review of valued component selection. However there is potential to find nesting sites, and if these features are found they will be addressed per mitigation identified in the Wildlife Management Plan. Nests are specifically protected for this species under the BC *Wildlife Act*.
Rusty blackbird (*Euphagus carolinus*)	Special Concern	Special Concern	Low	No	Range reported as south Alaska, south central British Columbia east of coastal ranges (Kamloops, Penticton; Campbell et al. 2001). Nearest known occurrences near Stewart and Hyder.	Habitat in winter range (conversion of wetlands), blackbird control programs	A minimal amount of breeding habitat suitable for the rusty blackbird overlaps with the Project. The species favours wet areas, swamps and marshes, which coincides with habitat identified for western toad in the wildlife effects assessment. Mitigation for the Project, as outlined in the WMP, addresses minimizing disturbance to this habitat and will protect active nests on a site specific basis should they occur.
Band-tailed pigeon (*Patagioenas fasciata*)	Special Concern	Special Concern	Moderate	No	Range reported as far north as southwest British Columbia (lower Fraser River basin on mainland (Campbell et al.1990) with probably breeding in southeast Alaska. Nearest known occurrences near Stewart and Hyder.	Loss of habitat, low reproductive output (dependence of mineral sites-contaminated from industrial activities), invasive species, disease	The Project is in the northern extent of the species range. The species was not detected in baseline surveys and is not commonly detected in the region. The COSEWIC status report on the species (2008) states "In British Columbia, the Band-tailed Pigeon breeds from near sea level to 760 m elevation in edges and openings in mature coniferous, mixed and deciduous forests, city yards and parks, wooded groves, open bushland, golf courses and orchards. Mineral sites are critical seasonal habitat as sources of sodium." There is very minimal if any habitat suitable for band-tailed pigeon within the Project and very little chance for interaction given there is little new disturbance associated with low elevation forests. Should nests occur, they will be protected per the Wildlife Management Plan for the Project.
Barn swallow (*Hirundo rustica*)	Threatened	No status	Low	No	Breeds southeast Alaska south to US border (Campbell et al. 1997). Several occurrences reported near Stewart/Hyder (eBird).	Low nesting/foraging sites from agricultural practices, low insect populations, weather perturbations (cold snaps on breeding grounds)	Barn swallows have a low potential to occur in the Project area. The species breeds across British Columbia in open habitats and tends to build nests on artificial structures. Barn swallows have the potential to nest on cliff faces. Mitigation for the Project outlined in the WMP addresses minimizing impacts to barn swallows by minimizing disturbance and identifying wildlife features such as barn swallow nests prior to disturbance.
Evening grosbeak (*Coccothraustes vespertinus*)	Special Concern	No status	Low	No	East and southern British Columbia, including Vancouver Island (Godfrey 1986); abandons portion of northernmost breeding range during winter (Semenchuk 1992). No known occurrences in the project regional study area (eBird).	Reduced mature/old growth mixed wood and conifer forests, window collisions, feeding on grit/salt along roadsides (winter)	The Project is beyond the mapped northern extent of the species range (Scot and Byers 2001). The species was not detected in baseline surveys and there are no known occurrences in the Project Regional Study Area according to the BC Breeding Bird Atlas and eBird spatial mapping. There is a low potential for occurrence in the Regional Study Area and low potential for negative interactions of habitat with the Project. Should nests occur, they will be protected per the Wildlife Management Plan for the Project.

Species	COSEWIC	SARA	Potential to Occur within the LSA	Species detected during baseline[1]	Distribution (BNA, CDC, eBird)[2]	Threats (COSEWIC status reports)	Rationale – Species was not assessed for effects as a Valued Component
Coastal tailed frog (*Ascaphus truei*)	Special Concern	Special Concern	Low	No	Nearest known occurrences near Prince Rupert (BC Frogwatch).	Tadpoles are vulnerable to massive substrate movements which can be compounded by road building or activities that alter hydrological regimes or increase fine sediment in substrates. An emerging fungal disease, chytridiomycosis, is a potential threat to coastal tailed frog in BC.	There have been no recorded sightings of coastal tailed frogs during baseline surveys that specifically focused on occurrences of the species. BC Frogwatch shows the closest sighting to be south of Prince Rupert and west of Ecstall River. There is a low potential for occurrence in the Regional Study Area and low potential for negative interactions of habitat with the Project. The WMP outlines mitigation measures for amphibians that focuses on wetland habitat which encompasses potential habitat of coastal tailed frog.
Woodland caribou (*Rangifer tarandus*)	Varied depending on population	Varied depending on population	None	N/A	N/A	N/A	Woodland caribou range does not overlap with the project footprint and therefore was not assessed.

1. Refer to Red Mountain Wildlife Baseline Report (Appendix 16-A) for survey level of effort
2. BNA = Birds of North America; CDC = BC Conservation Data Centre; eBird: Cornell Lab of Ornithology http://ebird.org/content/ebird/

Measurement indicators were used to characterize both existing conditions and changes to VCs along effect pathways. They were used to evaluate the interaction of Project components and activities with each VC and to consider the effectiveness of mitigation measures. Measurement indicators must be relevant, practical, measurable, responsive, accurate, and predictable to inform the understanding of potential Project effects. Measurement indicators may be quantitative (e.g., habitat availability through changes in quantity or quality) or qualitative (e.g., a discussion of anticipated changes in movement due to habitat disturbance based on a literature review).

The following measurement indicators were used to assess the potential effects of the Project on each Wildlife VC (Table 16.3-4):

- **Habitat availability**: changes to the amount of habitat available as a result of habitat loss or alteration and sensory disturbance;
- **Habitat distribution**: changes to habitat distribution as a result of Project components or activities that could disrupt habitat connectivity and wildlife movements, making otherwise suitable habitats unavailable or unusable.
- **Mortality risk**: changes to wildlife mortality via direct and indirect pathways including disruption or removal of breeding sites (e.g., nests, burrows, or dens) during vegetation clearing or ground disturbance activities; collisions with vehicles, powerlines, or buildings; increased hunting pressure (both legal and illegal) due to improved access; new travel corridors that may facilitate predator access; and exposure to chemical hazards or attractants that may initiate unfavorable human-wildlife interactions.

The assessment endpoint for all Wildlife VCs is the maintenance of ecological conditions that support populations relative to baseline conditions.

Table 16.3-4: Wildlife VC Selection Rationale, Assessment Endpoints and Measurement Indicators

Valued Components	Primary Measurement Indicators	Assessment Endpoints	Rationale for Selection
Mammals • Mountain goat • Grizzly bear • Moose • Furbearers, including marten and wolverine • Hoary marmot • Bats, including Keen's myotis, little brown myotis, and northern myotis	• Habitat availability (changes to the amount or quality of habitat) • Habitat distribution (changes to habitat distribution and effects to habitat connectivity • Mortality risk (changes to wildlife mortality through direct and indirect effects)	Maintenance of ecological conditions that support populations relative to existing baseline	Mammal VCs were selected due to their status as listed species, and/or their value as a resource to the public and NLG. • Mountain goats are important to NLG due to Nisga'a Nation's Treaty rights to hunt in the Nass Wildlife Area, and their status as a blue-listed species in British Columbia. • Grizzly bears are important to NLG due to Nisga'a Nation's Treaty rights to hunt in the Nass Wildlife Area. Grizzly bears are also important due to their status as a blue-listed species in British Columbia and a species of Special Concern under COSEWIC. • Moose are important to NLG due to Nisga'a Nation's Treaty rights to hunt in the Nass Wildlife Area. • Furbearers are important to NLG due to Nisga'a Nation's Treaty rights to trap in the Nass Wildlife Area. In addition, marten represent furbearer habitat requirements that potentially interact with the Project, and wolverines are a blue-listed species in British Columbia and a species of Special Concern under COSEWIC. • NLG have identified hoary marmots as a VC due to their importance as a food source for grizzly bears. • Keen's myotis are important due to their status as a blue-listed species in British Columbia; they are also identified as "data deficient" under COSEWIC and are identified as a special concern species on Schedule 3 of the SARA (SARA Schedule 1 provisions do not apply). Little brown myotis are important due to their status as an endangered species on Schedule 1 of the SARA. Northern myotis are important due to their status as a blue-listed species in British Columbia and an endangered species on Schedule 1 of the SARA.
Birds • Migratory breeding birds, including MacGillivray's warbler • Migratory birds species at risk, including black swift, common nighthawk, marbled murrelet, and olive-sided flycatcher • Raptors, including northern goshawk *laingi* subspecies and western screech-owl *kennicottii* subspecies Non-migratory Game Birds, including sooty grouse and white-tailed ptarmigan	• Habitat availability (changes to the amount or quality of habitat) • Habitat distribution (changes to habitat distribution and effects to habitat connectivity • Mortality risk (changes to wildlife mortality through direct and indirect effects)	Maintenance of ecological conditions that support populations relative to existing baseline	Bird VCs were selected due to their status as listed species, and/or their value as a resource to the public and NLG. Focal species were selected using two criteria: i) species at risk that may have potential interactions with the Project or ii) species that represent each broad habitat type that may have potential interactions with the Project (i.e., alpine, old/mature forest, riparian, shrub/early successional). • Migratory birds are protected under the MBCA 1994. Focal species represent broad habitat types including early successional (common nighthawk), old/mature forest (olive-sided flycatcher and marbled murrelet), and shrub/riparian (MacGillivray's warbler). • Black swift is a blue-listed species in British Columbia and an endangered species under COSEWIC. • Common nighthawk is a Threatened species on Schedule 1 of the SARA. • Marbled murrelet is a blue-listed species in British Columbia and a Threatened species on Schedule 1 of the SARA. • Olive-sided flycatcher is a blue-listed species in British Columbia and a Threatened species on Schedule 1 of the SARA. • Raptors provide an important role in ecosystems as top food chain predators. Focal species represent broad habitat types including old/mature forest (northern goshawk) and riparian (western screech-owl). • Northern goshawk *laingi* subspecies is a red-listed species in British Columbia and a Threatened species on Schedule 1 of the SARA. • Western Screech-owl *kennicottii* subspecies is a blue-listed species in British Columbia and a species of Special Concern on Schedule 1 of the SARA. Non-migratory game birds include species identified by NLG as important and are a resource to the public for recreational hunting. Focal species represent broad habitat types including alpine and old/mature forest (sooty grouse) and alpine (white-tailed ptarmigan).
Amphibians • Western toad	• Habitat availability (changes to the amount or quality of habitat) • Habitat distribution (changes to habitat distribution and effects to habitat connectivity • Mortality risk (changes to wildlife mortality through direct and indirect effects)	Maintenance of ecological conditions that support populations relative to existing baseline	• Western toads were selected due to their status as a listed species. • Western toads are a blue-listed species in British Columbia and a species of Special Concern on Schedule 1 of the SARA.

16.3.4 Assessment Boundaries

16.3.4.1 Spatial Boundaries

16.3.4.1.1 Project Footprint

The Project footprint is the smallest spatial boundary and includes the area within which physical activities will occur (Figure 16.3-1). The total Project footprint is 198 hectares (ha) and includes the proposed road and infrastructure.

16.3.4.1.2 Local Study Area

The LSA encompasses the Project footprint and extends beyond it to include the Bitter Creek watershed, which is the surrounding area that contains the extent of potential Project-related effects (Figure 16.3-1). The LSA is 15,877 ha and extends from the mouth of Bitter Creek to the headwaters at the base of the Bromley Glacier and the edge of the Cambria Icefields. The LSA encompasses the area where Project-related effects are expected to occur for the Wildlife VCs.

16.3.4.1.3 Regional Study Area

The RSA is the largest spatial boundary scale. It encompasses the LSA and extends beyond it to include the Bear River watershed, with inclusion of adjacent sub-watersheds that were interpreted as providing regional biological context for the most wide-ranging species that interact with the Project (Figure 16.3-1). The objective was to identify a contiguous area that would provide a regional context to the Wildlife VCs. The RSA is 205,350 ha and extends from Meziadin Lake in the east to the head of the Portland Canal in the west, and from Hastings Arm in the south to the upper end of the American Creek watershed to the north. This RSA also represents the area within which cumulative effects on Wildlife VCs may occur. The RSA is the assessment boundary for analysis of potential residual Project-related effects and of potential cumulative effects, with the exception of two VCs: hoary marmot and bats. The LSA was considered a more relevant assessment boundary for these two species due to the range of individuals within a population of those species.

16.3.4.1.4 Zones of Influence

Habitat adjacent the Project footprint, while remaining structurally unchanged, will become less effective for some wildlife because of the sensory disturbances associated with Project activities. The Zone of Influence (ZOI) is a theoretical area surrounding the Project footprint that encompasses this adjacent, unchanged habitat. The ZOI is specific to each wildlife species and its spatial extent is based on biological rationale (Table 16.3-6). Noise (Chapter 8) is an intermediate component (IC) identified in the AIR that informed the assessment and was used to define ZOIs for certain VCs. There were four ways a ZOI was defined, depending on species:

i) **No ZOI**: Certain species were considered not susceptible to sensory disturbance and were not assigned a ZOI in addition to the Project footprint.

ii) **ZOI based on noise level**: Some species were judged to be potentially affected by Noise as the primary source of disturbance. The operational noise model for the Project (Appendix 8-A) was used to define a ZOI based on ambient noise guidelines for mining operations. The Environmental Code of Practice for Metal Mines (EC 2009) recommends that off-site ambient noise levels from mining operations in remote locations should not exceed 55 dBA during the day and 45 dBA during the night. The noise model predicted the A-weighted equivalent continuous sound levels for the continuous emission of noise from the Construction Phase and Operation Phase. The isopleth encompassing 55 dBA (day) / 45 dBA (night) for the Operation Phase noise was used as the ZOI boundary. This noise threshold was considered a conservative approach for application to Wildlife. A 45 dBA noise level is comparable to a typical human conversation in a quiet room.

iii) **ZOI based on distance from footprint**: For certain species, there was evidence that animals respond to disturbance through visual and auditory means up to a distance around a source. For example, mountain goats are known to be sensitive to ground disturbance up to distances of 500 m.

iv) **ZOI based on distance from footprint and noise level**: For some species there was evidence that animals respond to a source of noise and to disturbance up to a distance around an activity. In these cases, the isopleth in the noise model encompassing 55 dBA (day) / 45 dBA (night) for the Operation Phase noise was merged with the distance determined appropriate for the species. This combined polygon was used as the ZOI in these cases.

ZOIs do not define the spatial boundary of the effects assessment. They are used in the assessment of potential residual effects on Wildife VCs.

Table 16.3-5: Zones of Influence for Wildlife Valued Components

Wildlife VC	ZOI	Rationale
Mountain goat	Geographic extent of noise model plus 500 m buffer	Winter and summer habitat occurs in the LSA. Goats were observed in the LSA in both seasons during baseline surveys. Goats are especially sensitive to disturbance during winter (Nov 1-Apr 30) and kidding/rearing/mineral lick use (May 1-Jul 15) (MGMT 2010). A ZOI of 500 m corresponds to a disturbance zone and recommended buffer for ground-based industrial activities (MGMT 2010). This ZOI contains the area where modelling predicted continuous noise from operations of a maximum 55 dBA (day) / 45 dBA (night).
Grizzly bear	Geographic extent of noise model	Road traffic and other activities can disturb grizzly bears and cause them to avoid otherwise effective habitat. Few data identify the distance within which grizzly bears are disturbed by noise and other activity. In Alaska, seismic activity had a physiological effect on hibernating grizzly bears and that seismic testing activities closer than 200 m from a den may result in den abandonment (Reynolds et al. 1986). In Montana, grizzly and black bears (*Ursus americanus*) used habitat less than 1000 m from a road or trail less than expected (Kasworm and Manley 1990) and grizzly bears had a neutral or positive selection for areas around closed roads or those with <10 vehicles/day but avoided 500 m buffers around

Wildlife VC	ZOI	Rationale
		roads with >10 vehicles/day (Mace et al. 1996). Similar results were found in Banff National Park but the authors concluded that grizzly bears use high-quality habitat adjacent to roads as they become habituated to traffic and that relatively constant, predictable traffic did not have a negative stimulus associated with it. (Chruszcz et al. 2003). Others have similarly found that grizzly bears become habituated to predictable disturbances (Herrero 1985, Jope 1985, McLellan and Shackleton 1989). In light of the above information, a conservative approach was taken for the definition of the ZOI in which noise modeling results identifying the boundary where continuous noise can reach a maximum of 45 dBA (night) / 55 dBA (day) from operation activities. Where a prediction of noise level was not available for projects included in the Cumulative Effects Assessment (CEA), the ZOI was set at a distance of 500 m. These projects range from having traffic >10 vehicles/day (Highway 37A) to having infrequent activity (i.e., maintenance on Long Lake transmission line). This is considered a conservative approach in light of the above information.
Moose	Geographic extent of noise model	Moose respond to both human and motorized disturbances but it is not known if cues are visual, auditory or both. Moose have been found to alter their behaviour within 150 m of snowmobile trails (Colescott and Gillingham 1998) and 500 m of cross-country ski trails (Ferguson and Keith 1982). Moose exposed to these types of activities increased their movement rates and diurnal activity ranges and left the area of disturbance but overall responses were short in duration, which suggests there was a negligible effect on the overall energy budget of moose in good condition when disturbances occur at moderate frequency (Neumann et al. 2011; Harris et al. 2014). A conservative approach was taken to define the ZOI for moose. It is assumed that moose will respond to either visual or auditory clues but that auditory stimuli can be sensed over a longer distance. The ZOI is therefore defined as the outer boundary where noise can reach a maximum of 45 dBA (night) / 55 dBA (day) as a result of continuous operation activities. Where a prediction of noise level was not available for projects included in the CEA, a ZOI was not applied. In light of the above information, potential avoidance of existing/future activities such as those included in the CEA is likely to result in a negligible effect on moose.
Marten	Geographic extent of noise model	Information on the effects of disturbance on marten is limited. In California, off-highway vehicles had no measurable effect on marten occupancy or probability of detection but behavioural, physiological, and demographic responses were not measured (Zielinski et al. 2008). A precautionary approach has been taken for the ZOI of marten in this Project. The ZOI has been defined as the outer boundary where noise can reach a maximum of 45 dBA (night) / 55 dBA (day) as a result of continuous operation activities. Where a prediction of noise level was not available for projects included in the CEA, a ZOI was not applied to other projects and activities for marten. In light of the above information, potential avoidance of

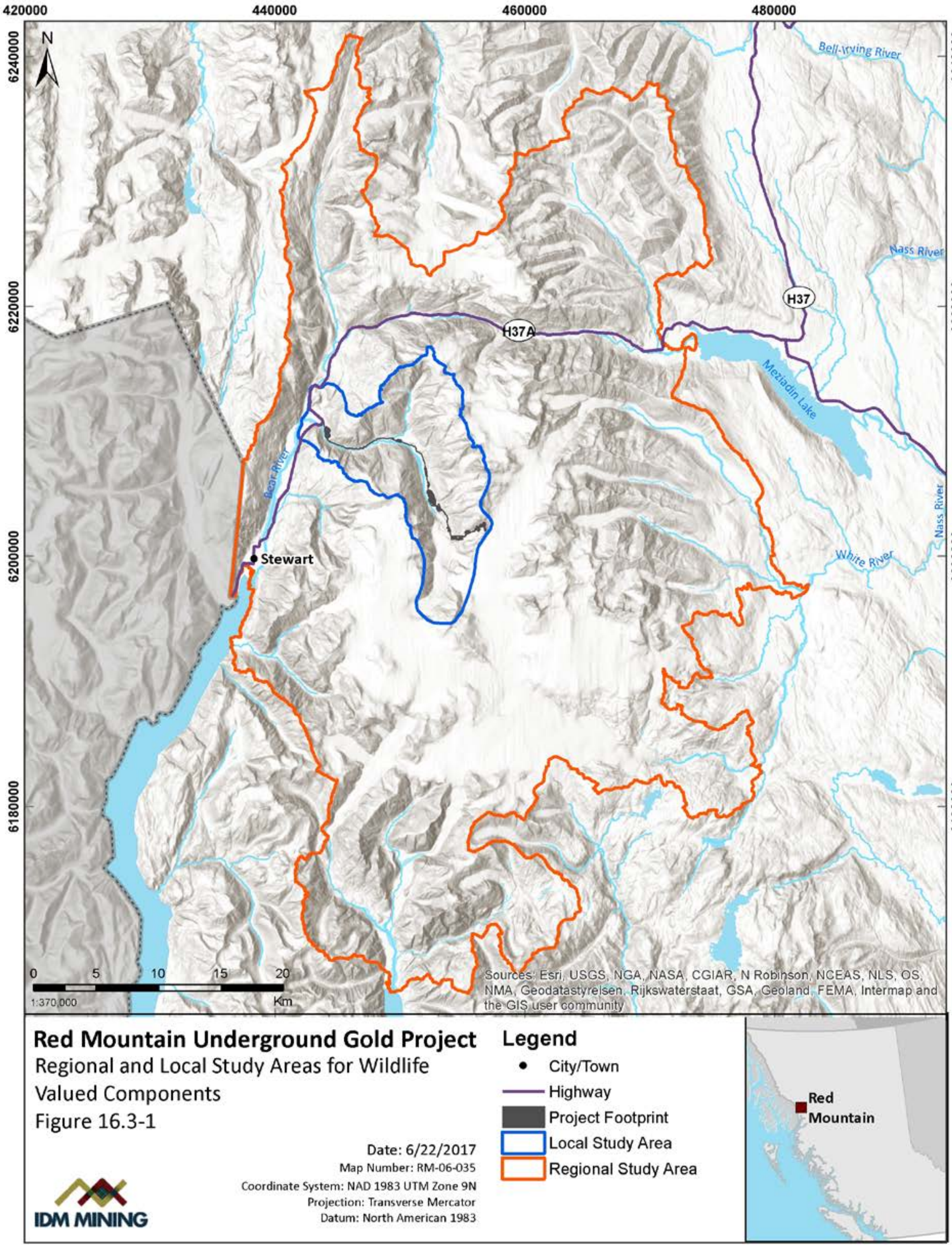
Wildlife VC	ZOI	Rationale
		existing/future projects or activities such as those included in the CEA is not likely to result in a greater than negligible effect on marten.
Wolverine	Geographic extent of noise model	Wolverines are known to be adverse to humans and human developments. Forestry and mining can displace or alter movement paths of wolverine (Lofroth 2001). Roads can alter daily movements (Austin et al. 2000) or be a source of mortality (Krebs and Lewis 1999). Recreation may disturb wolverine, particularly during the denning season (Slough 2007). Larger, more mobile mammals with lower reproductive rates are more susceptible to road mortality and those that avoid roads are susceptible to diminished habitat effectiveness (Fahrig and Rytwinski 2009). The distance over which wolverine can be affected by noise and other disturbance is not known. In light of this uncertainty, a precautionary approach has been taken. It is assumed that disturbance will have a negative effect on habitat effectiveness adjacent to the Project footprint. As a result, the ZOI has been defined as the outer boundary where noise can reach a maximum of 45 dBA (night) / 55 dBA (day) as a result of operation activities. Where a prediction of noise level was not available for projects included in the CEA, the ZOI was set at a distance of 500 m surrounding each project. These projects range from having a traffic >10 vehicles/day (Highway 37A) to having very infrequent activity or traffic (i.e., maintenance of vegetation on Long Lake transmission line). This is considered a conservative approach in light of the above information.
Hoary marmot	None	Effects of sensory disturbance were determined to have no interaction with hoary marmot. Hoary marmots frequently habituate to human disturbance. There is evidence to suggest behavioural shifts from foraging to increased vigilance can occur as a result of human presence (Li et al. 2011). However, comparable survival rates, reproduction rates, or body conditions between marmots exposed to human presence and those unexposed indicate these behavioural shifts are not anticipated to have a population effect (Griffin et al. 2009). As a result, no ZOI has been implemented for the effects assessment on hoary marmot.
Bats (Keen's myotis, little brown myotis, northern myotis)	Geographic extent of noise model	Potential sensory disturbance would be associated with lights at night at the mine facilities and noise related to ongoing operations at night only within the footprint. Lights have the risk of attracting high abundance of insects and thus bats, while noise may affect foraging in the area to a limited extent. In either case, it is anticipated these effects would be mitigated by standard mitigation measures: noise restrictions, properly maintained equipment, standard noise dampening measures, and the use of directed/focused lighting rather than broad area lighting. The noise model was used as the ZOI because the 45 dBA (night) / 55 dBA (day) boundary encompasses the area of noise and light that has potential to affect bat habitat.

Wildlife VC	ZOI	Rationale
Migratory breeding birds (including MacGillivray's warbler)	Project footprint plus 150 m buffer	Response to habitat alteration varies among bird species and individuals and can lead to a decline in bird density and/or a change in the bird community within a distance around the source of the disturbance. Based on scientific knowledge of effects caused by disturbance, sensory disturbance for migratory breeding birds was assessed within the Project footprint plus a 150 m ZOI around the Project footprint. The range of disturbances reported in the literature was typically a higher level of continuous noise and traffic volume than in the Project; therefore the lower distance from disturbance in the range reported was used as the ZOI. For example, several studies reported effects on a range of bird species close to compressor stations (Francis et al. 2009), in addition to 200 m to 300 m and up to 700 m from compressor stations (Habib et al. 2007, Bayne et al. 2008). The effects of roads and road traffic on bird habitat use given a road with 10,000 vehicles per day estimated the maximum size of the ZOI in woodland and grassland habitats to be 125 m and 190 m, respectively, for all species combined; the size of the ZOI in woodland and grassland habitats increased up to 305 m and 365 m, respectively, for certain species (Reijnen and Foppen 1997). Smith et al. (2005) suggested that the strongest effects of noise on breeding birds typically occur within 100 to 300 m of roads. Traffic volume of roads in available studies is typically much higher than traffic on roads in the RSA and in the LSA. As context, traffic volumes on major highways in Okanagan valley and East Kootenay region of British Columbia are approximately 11,350 and 4,500 vehicles per day, respectively, compared to traffic volumes along Highway 37 and Highway 37A of 693 and 253 vehicles per day, respectively (BC MOTI 2017). Furthermore, the expected annual traffic volume for the Project is 15,140 loads over eight years, which equates to 5.18 loads per day.
Black swift, common nighthawk, and olive-sided flycatcher	Project footprint plus 150 m buffer with noise model	Response to disturbance varies among bird species and individuals and can lead to a decline in bird density and/or a change in the bird community within a distance around the source of the disturbance. Based on scientific knowledge of similar disturbances (see references for migratory breeding birds), sensory disturbance for migratory bird species at risk was assessed within the Project footprint plus a 150 m ZOI around the Project footprint. Further, the 45 dBA/55 dBA continuous noise threshold was used based on recommended noise thresholds from government guidelines (EC 2009) and knowledge of effects to birds resulting from noise. Several studies have identified chronic noise threshold values of 47 ± 3.5 dBA near roads (Reijnen and Foppen 1994, Reijnen et al. 1995; Reijnen et al. 1996b).

Wildlife VC	ZOI	Rationale
Marbled murrelet	Project footprint plus 300 m buffer	A ZOI of 300 m for marbled murrelet was defined based on potential for indirect effects to habitat quality that may result from edge effects and increased potential for predation. Indirect effects include indirect habitat alteration adjacent to vegetation clearing that result from edge effects such as increased insolation and exposure to wind. These effects have been identified as occurring up to about 140 m from "hard" edges, i.e., those with a dramatic change in structure such as old-growth forest adjacent to a recent clearing (e.g., Chen et al. 1992, Voller 1998) but can extend as far as 240 m in extreme circumstances, for example an old-growth forest edge exposed to extreme heat and wind on a southern exposure (Chen 1991). Indirect edge effects can also include a greater risk of predation, though the potential for, degree of and distance over which increased predation may occur is highly variable (Vetter et al. 2012). On Vancouver Island, predation on artificial nests was greatest within the first 10 m of a hard edge, decreased up to 130 m and was not detectable at 200 m. The same study found that steller's jay (*Cyanocitta stelleri*) was the most abundant predator of marbled murrelet nests and that its density was greater at clear-cut and road edges than within forest interiors or at river edges (Burger et al. 2004). As a result of these potential indirect effects, a ZOI of 300 m has been used to estimate potential indirect effects to marbled murrelet nesting habitat. This is considered a conservative estimate and is more likely to over-estimate rather than under-estimate indirect project effects. Effects to habitat as a result of sensory disturbance caused by noise during construction or operation are not included in the indirect effects assessment. Marbled murrelets are daily migrators, primarily migrating at or around dawn dusk. Due to their crepuscular timing, daytime noise disruptions are expected to be less than for other species. Further, 96% of atlassed marbled murrelet nests have been found below 250 m with only one record above 500 m (Burger 2015). The bulk of the operational activity will occur at relatively high elevation near the Mine Site; for example, the main portal will be at approximately 1,860 m and the haulage ramp will be above 1,700 m. This further reduces the potential for interaction between marbled murrelet nesting and operational activities.
Northern goshawk	Project footprint plus 500 m buffer	A 500 m ZOI around all Project infrastructure for nesting habitat and foraging habitat was applied based on available information. For example, McClaren et al. (2015) recommends a minimum 500 m buffer for most mechanized activities around active coastal goshawk nest sites between February 15 and September 15.

Wildlife VC	ZOI	Rationale
Western screech-owl	Project footprint plus 300 m buffer	A 300 m ZOI around past and future projects is based on the Province of British Columbia recommendation of a minimum 200 m buffer in rural areas for nesting western screech-owls with an additional 100 m breeding season 'quiet' buffer (BC MOE 2013a). The buffer around specific nest sites applied as the ZOI is a precautionary approach that presumes there could be nesting sites within the effective habitat for western screech-owl that would be reduced in effectiveness within 300 m of the Project footprint.
Sooty grouse and white-tailed ptarmigan	Project footprint plus 300 m buffer with noise model	Whitfield et al. (2008) suggested breeding grouse and ptarmigan respond to human activity at a distance of 150 m. Response to noise varies among species and can extend up to 3,000 m from a point source, with the strongest effects generally occurring over short distances (up to approximately 300 m) (Smith et al. 2005).
Western toad	None	Sensory disturbance is not considered a potential effect as the western toads in northwest British Columbia are part of the non-calling subpopulation (COSEWIC 2012c) and are not sensitive to increased noise levels.

Figure 16.3-1: Regional and Local Study Areas for Wildlife Valued Components



16.3.4.2 Temporal Boundaries

The temporal boundaries for the assessment of Project-related effects on Wildlife VCs encompass the time periods during which the proposed Project is expected to interact with Wildlife VCs (Table 16.3-6).

Table 16.3-6: Temporal Boundaries for the Effects Assessment on Wildlife

Phase	Project Year	Length of Phase
Construction	Year -2 to Year -1	18 months
Operation	Year 1 to Year 6	6 years
Closure and Reclamation	Year 7 to Year 11	5 years
Post-Closure	Year 12 to Year 21	10 years

16.3.4.3 Administrative and Technical Boundaries

Administrative boundaries refer to the limitations imposed on an environmental assessment by political, economic, or social constraints. No administrative boundaries were identified for the assessment of Wildlife VCs.

Technical boundaries refer to the constraints imposed on an environmental assessment by limitations in the ability to predict the effects of a Project. Technical boundaries that may impose constraints on the ability to predict the effects of the Project on Wildlife VCs include:

- Limited information on species ranges and population numbers in the region;
- Limited knowledge of habitat requirements for species at risk and species that rarely occur in the region;
- Limited knowledge of species and individual response to disturbance and the relationship to potential population-level effects;
- Use of predictive habitat models to assess potential Project-related effects; and
- Existing data (i.e., provincial forest data, Predictive Ecosystem Mapping [PEM] and Terrestrial Ecosystem Mapping [TEM], imagery) was limited in coverage across the RSA.

16.4 Existing Conditions

16.4.1 Overview of Existing Conditions

The Project is located in northwest BC within the South Boundary Ranges Ecosection of the province, west of the Nass Basin. More specifically, the Project is located within the Bitter Creek watershed, a tributary to the Bear River, which flows southwest to the Portland Canal and Pacific Ocean. The nearest community is the townsite of Stewart, approximately 18 kilometres (km) southwest of the Project. The nearest year-round residences to the Project outside of Stewart are at Meziadin Junction, approximately 65 km from the Project, and seasonal residences are at Bell II, which is approximately 153 km from the Project.

Typical of the Southern Boundary Ranges, the area surrounding the Project consists of rugged coastal mountains with steep topography, narrow valleys, and few lakes. Glaciers and icefields are prevalent in the upper elevations. The Bitter Creek watershed ranges in elevation from approximately 500 to 2,700 metres above sea level (masl). Red Mountain, which holds the targeted ore deposits, is situated between the Cambria Icefield and Bromley Glacier. To the northeast, lies Meziadin Junction on the shores of Meziadin Lake. The Clements Lake Recreation Area is approximately 17 ha and is located near the confluence of Bitter Creek and Bear River, outside of the Bitter Creek valley.

The climate is typically cool and wet with heavy precipitation year round. Heavy snow packs (up to 3 m) are typical. The following biogeoclimatic zones (BGC) are represented in the RSA:

- Coastal Western Hemlock (CWH). This zone is the majority of low elevation within the RSA and includes major watersheds along the southern and western boundaries, such as the Bear, Sutton, and Kshwan rivers and Bitter and Strohn creeks. This zone is 17,728 ha and approximately 9% of the RSA. Dominant tree species are western hemlock (*Tsuga heterophylla*) and Sitka spruce (*Picea sitchensis*).

- Interior Coastal Hemlock (ICH). Valley bottoms to the east and north within Strohn Creek and White River are within the ICH zone. This zone accounts for 5% of the RSA and does not extend into the LSA. Dominant tree species include western hemlock and western red cedar (*Thuja plicata*). The moisture regime of the ICH is slightly drier than the CWH and is located within the rain-shadow of the Coastal Mountains.

- Mountain Hemlock (MH). The MH is immediately above the ICH. Dominated tree species are mountain hemlock (*Tsuga mertensiana*) and amabalis fir (*Abies amabilis*). Yellow cedar (*Chamaecyparis nootkatensis*) is also infrequently present. Approximately 36% of the RSA is classified as MH. In the upper elevations (1,200 to 1,300 masl), this zone transitions from a forested ecosystem to true alpine.

- Coastal Mountain-heather Alpine (CMA). The CMA is above 1,300 masl and is the largest zone within the RSA (103,167 ha or 50%). This zone is characterized by low stunted vegetation as a result of an extremely short growing season.

Characterization of baseline conditions of Wildlife VCs and their regional context are provided in subsequent discussions (Section 16.4.3 to 16.4.6).

16.4.1.1 Land Constraints

Land constraints within the RSA are primarily crown mineral tenures. Private land ownership is largely restricted to areas within the District of Stewart and Meziadin Junction. Large tracts of crown mineral tenures are located along the Bear River and its major tributaries. Mineral tenure claims are also present on the eastern boundary of the RSA near the confluence of White River and Willoughby Creek. Within the LSA, mineral tenures are focused in the upper elevations extending from Roosevelt Creek to the Bromley Glacier. These mineral tenures are held by IDM.

16.4.1.2 Parks and Protected Areas

One provincial park occurs within the Project RSA (Data BC 2017a). Bear Glacier Provincial Park is a Class “A” provincial park that was established in 2000 (BC MWLAP 2003). It is a 542 ha park located along Highway 37A, approximately 25 km west of Meziadin Junction and 40 km east of Stewart. This park does not overlap the Project LSA.

16.4.1.3 Wildlife Habitat Areas and Ungulate Winter Ranges

The Project RSA overlaps 237 ha of an approved Wildlife Habitat Area (WHA) established as a Specified Area for Species at Risk (i.e., WHA 6-282 for grizzly bear; Data BC 2017f). The portions of this WHA that overlap the Project RSA occur along the eastern edge of the RSA south of Meziadin Lake along Nelson Creek, Willoughby Creek, and White River. There are no approved WHAs within the Project LSA.

The Project RSA overlaps 17,056 ha of three approved Ungulate Winter Ranges (UWR) established for mountain goat or moose (Data BC 2017e). Portions of UWR U-6-010 for mountain goat (i.e., 5 ha) overlap the western edge of the RSA south of Stewart between Bulldog Creek and Marmot River. Portions of UWR U-6-002 for mountain goat (i.e., 16,444 ha) broadly overlap the northern two-thirds of the Project RSA. This UWR also overlaps 2,276 ha of the Project LSA within the Bitter Creek watershed. Portions of UWR U-6-018 for moose (i.e., 607 ha) overlap the eastern edge of the RSA along the west end of Meziadin Lake and along Willoughby Creek before it enters White River.

16.4.1.4 Wildlife Management Units

Wildlife Management Units (MU) are designated under the BC *Wildlife Act* for the purpose of game management in BC. The Project RSA overlaps portions of MU 6-14 and MU 6-16; the Project LSA is located entirely within MU 6-14 (Data BC 2017g). Mountain goat harvesting is permitted annually in MU 6-14 and MU 6-16 from August 1 to November 15, although a portion of MU 6-16 is closed. Moose harvesting is not permitted in MU 6-14 or MU 6-16. Wolverine harvesting is permitted annually in MU 6-14 and MU 6-16 from September 15 to February 28. Grouse harvesting is permitted annually in MU 6-14 and MU 6-16 from September 1 to November 15 and ptarmigan harvesting is permitted annually in MU 6-14 and MU 6-16 from August 15 to February 28. Refer to the Hunting and Trapping

Regulations Synopsis 2016-2018, Skeena Region 6 for bag limits and further details (FLNRO 2016b).

The Project RSA and LSA are also located entirely within the Stewart Grizzly Bear Population Unit, which has a viable population status based on expert opinion (Data BC 2017b). Grizzly bear hunting is permitted in the Stewart Grizzly Bear Population Unit in accordance with limited entry hunting regulations (FLNRO 2017a).

16.4.1.5 Nass Wildlife Area

The Project RSA and LSA are located entirely within the Nass Wildlife Area. The Nass Wildlife Area is a 16,101 km² area set out in NFA that allows for specific Nisga'a Nation allocations for designated wildlife species (i.e., mountain goat, grizzly bear, and moose) (NLG 2017c). The proposed Nisga'a Nation allocation for mountain goats in the 2014–2016 Wildlife Management Plan was 33 goats per year (NLG 2014). The proposed Nisga'a Nation allocations for grizzly bear and moose were seven bears per year (no more than two females) and 25 moose per year (all bulls) (NLG 2014).

The Nass Wildlife Area is divided into mountain goat management blocks that assist with overall population management by facilitating annual determinations for total allowable harvest, Nisga'a Nation harvest allocation, and Nisga'a Nation harvest locations throughout the Nass Wildlife Area (NLG 2014). The Project LSA is located within NLG mountain goat block (MGB) 25. Mountain goat harvesting by Nisga'a citizens is permitted within this management block; most goats are harvested between early September and end of December, with a few goats harvested between April and mid-May (NLG 2014).

16.4.1.6 Trapping and Guide Outfitter Licenses

The entire Project LSA is located within trapping license TR0614T101. A total of 12 trapping licences are overlapped by the Project RSA (Data BC 2017d). These include:

- TR0614T094
- TR0614T095
- TR0614T096
- TR0614T097
- TR0614T099
- TR0614T100
- TR0614T101
- TR0616T008
- TR0616T009
- TR0616T010
- TR0616T011
- TR0616T012

The entire RSA is located within guide outfitter license 601084, which is held by Nisga'a Guide Outfitters, a division of Nisga'a Pacific Ventures LP (Data BC 2017c).

The Economic Effects Assessment (Chapter 19) includes an assessment of the Project's potential effects on these overlapping tenure holders. The potential effect of the Project on Nisga'a Guide Outfitters is also covered under the assessment of potential Project effects on Nisga'a Nation's interests in Chapter 27.

16.4.2 Past and Present Projects and Activities

A variety of current infrastructure and land-based activities occur within the Project RSA. Current infrastructure is largely limited to the Bear River valley and includes the District Stewart, the Highway 37A corridor that incorporates a high-voltage transmission line, Stewart Bulk Terminals, and the Stewart World Port. Past and current land-based activities within the RSA include forestry, mineral exploration and mining, public recreation and tourism, and hunting, fishing, and trapping activities. Past forestry activity has occurred in the Bitter Creek valley from the confluence with the Bear River to Roosevelt Creek, leaving behind a deactivated logging road and a series of over-grown cut blocks totaling approximately 708 ha within 13 km of Highway 37A. The Bitter Creek valley also has a history of mineral exploration and mining, both past and current. The alpine portions of Goldslide Creek basin have old mining shafts, previous exploration roads, and a current fly-in exploration camp. Advanced exploration and engineering activities are currently in progress at the site on a seasonal basis with bulk goods and fuel being flown in via helicopter. No roads currently access the site, but all-terrain vehicle (ATV) trails are used for transportation between the exploration camp and the existing mine portal. In addition to Bear Glacier Provincial Park, there is a recreation site at Clements Lake offering camping, fishing, and hiking opportunities with trails accessing adjacent alpine areas on Ore Mountain. Eco and cultural tourism has also grown in the area and includes heli-skiing.

16.4.3 Project-Specific Baseline Studies

16.4.3.1 Data Sources

In gathering data to support the Wildlife Effects Assessment, IDM assessed existing data, conducted surveys to complete required baseline data, and compiled all data that was relevant to the effects assessment for this Project.

Where available, federal, provincial, and non-government information was reviewed for pertinent information, including the following:

- Enquiry with FLNRO staff and a NLG representative was completed to gather current inventory data, harvest data, and current management objectives. This included Dean Peard, BC MOE; Kristal Dixon, FLNRO; Len Vanderstar, FLNRO; and Mike Demarchi, NLG.

- UWRs and WHAs spatial data and supporting information were reviewed. The methodology used by FLNRO used to delineate mountain goat UWRs was reviewed (Keim 2006; Keim and Lele 2006; Pollard 2002).

- LRMPs and SRMPs were reviewed for wildlife management objectives.

- Data from similar projects in the region as applicable; for example, the environmental assessment applications for Brucejack Mine, KSM Project, Kitsault Project, and Kemess Underground were reviewed. Baseline data for these projects were obtained where available; for example, spatial data of mountain goat observations collected during baseline surveys for Brucejack Mine were available through the BC Wildlife Species Inventory database.

- Records of occurrences of Wildlife VC species contained in the BC Wildlife Species Inventory database and the BC Conservation Data Centre (BC CDC 2017) were gathered.

- Publicly available geographic spatial data (Data BC 2017) were used in various aspects of the effects assessment. This provided information regarding wildlife habitat distribution, historic resource activity, and land ownership and tenure.

- Data were acquired from eBird (eBird 2012) and the Atlas of the Breeding Birds of British Columbia (Bird Studies Canada 2013) to provide additional distribution and habitat use information for certain focal species.

- A combination of scientific journals and report catalogues were reviewed. Primary literature was used to develop species accounts that provided scientific rationale for habitat suitability modeling for the Project.

- Species at risk with potential to occur within the Project area were identified from the federal SARA and British Columbia Conservation Data Centre (BC CDC 2017).

Numerous baseline studies completed for the Project were used during the effects assessment for each VC. Further details of the data sources, field methodologies, habitat modeling methodologies, and results for each baseline study are summarized in baseline reports (Appendix 16-A: Baseline Wildlife Resources Report).

16.4.3.2 Primary Data Collection and Analysis Methods

16.4.3.2.1 Field Surveys

Knowledge about existing conditions within the Bitter Creek valley was augmented through field investigations conducted from 2015 to 2017 (Table 16.4-1). Objectives of these studies were to determine presence of species and/or their relative abundance and identify habitat suitability for Wildlife VCs. Depending on the focal species, different types of field surveys were conducted, including species-specific and opportunistic surveys, using a combination of ground and aerial methods. Field investigations were primarily limited to the LSA for all Wildlife VCs with the exception of mountain goat. Aerial surveys were conducted in the RSA for mountain goat in summer 2016 and March 2017.

Wildlife cameras were installed strategically throughout the LSA. The 10 cameras provided coverage across all BGC zones in the LSA and placement was based on known or potential movement corridors and high use areas determined by wildlife sign, trails, topographical features such as canyons, or other features constricting or funneling wildlife movements. Camera location was also determined in part by the location of proposed Project components, such as the proposed Access Road.

Methods used for field surveys were based on provincial inventory standard protocols and other published documents pertaining to data collection and analysis methods. Location of sampling or survey points were selected based on criteria such as: location of potential interaction between the Project and suitable habitat and representation of various categories of habitat suitability for model verification. For example, systematic transects were conducted within high moose habitat suitability following provincial standards (RIC

1998a) using a combination of pellet group counts and browse assessments. These data were then used in verification and refinement of the moose habitat model.

Selected standards for species inventory used in the Project include:

- Inventory Methods for Seabirds: Cormorants, Gulls, Murres, Storm-petrels, Ancient Murrelet, Auklets, Puffins, and Pigeon Guillemot (RIC 1997a);
- Standardized Inventory Methodologies for Components of British Columbia's Biodiversity: Shorebirds: Plovers, Oystercatchers, Stilts, Avocets, Sandpipers, Phalaropes and Allies (RIC 1997b);
- Ground-based Inventory Methods for Selected Ungulates: Moose, Elk and Deer (RIC 1998a);
- Aerial-based Inventory Methods for Selected Ungulates: Bison, Mountain Goat, Mountain Sheep, Moose, Elk, Deer and Caribou (RIC 2002);
- Inventory Methods for Bats (RIC 1998b);
- Inventory Methods for Bears (RIC 1998c);
- Inventory Methods for Pond-breeding Amphibians and Painted Turtle (RIC 1998e);
- Inventory Methods for Forest and Grassland Songbirds (RIC 1999b);
- Inventory Methods for Marbled Murrelets in Marine and Terrestrial Habitats (RIC 2001a);
- Inventory Methods for Raptors (RIC 2001b);
- Nesting Habitat of Marbled Murrelets in British Columbia Using Air Photo Interpretation and Low-level Aerial Surveys. (Burger 2004);
- Inventory Methods for Marbled Murrelet Radar Surveys (RISC 2006); and
- Ground-based Inventory Methods for Ungulate Snow-track Surveys (RIC 2006).

Table 16.4-1: Summary of Baseline Investigations Conducted Between 2015 and 2017

Valued Component	Baseline Survey	Date Survey Completed
Mountain goat	Surveys primarily conducted on an opportunistic basis while accessing the site or during other surveys	August 2015
	Species-specific aerial surveys (LSA)	August 2015 June and July 2016

Valued Component	Baseline Survey	Date Survey Completed
	Species-specific aerial surveys (RSA)	July 2016 (northern half of the RSA) August 2016 (southern half of the RSA)
	Species-specific aerial survey within NLG Mountain Goat Block 25 (includes LSA)	March 2017
	Species-specific ground surveys within the LSA (fixed observation stations)	July 2016 March 2017
	Habitat assessments within the LSA, including WHR field verification (2015 field season only)	August 2015 June and July 2016
	Wildlife cameras (LSA)	2015 and 2016 field visits March 2017
Grizzly bear	Reconnaissance surveys (LSA) • searching for sign including individuals, tracks, scat, trails, and rub or bite trees • detailed habitat assessment upon discovery of habitat use	August 2015 June and July 2016
	Aerial den survey (LSA)	August 2015
	Wildlife cameras (LSA)	2015 and 2016 field visits
Moose	Reconnaissance surveys (LSA) • searching for sign including individuals, tracks, pellet groups, and evidence of browse	2015
	Species-specific ground surveys (LSA) • pellet group counts • browse assessments	June 2016
Furbearers (marten and wolverine)	Reconnaissance surveys (LSA) • searching for sign including individuals, tracks, and scat	2015 and 2016 field visits
Hoary marmot	Reconnaissance surveys (LSA) • searching for sign including burrows and listening for the distinct high-pitched whistles that marmots make when they are alarmed	2015 and 2016 field visits
Bats	Species-specific ground surveys (LSA) • presence/not detected level	June 2016
	SM3BAT detectors (LSA)	June to August 2016
Migratory Breeding Birds (including McGillivray's warbler and olive-sided flycatcher)	Unlimited radius point count surveys (LSA)	June to July 2016

Valued Component	Baseline Survey	Date Survey Completed
Bird Species at Risk – common nighthawk	Species-specific ground surveys (LSA) • silent listening • call-playback	June and July 2016
	Automated recording units (LSA)	June to July 2016
Bird Species at Risk – marbled murrelet	Species-specific aerial survey and ground assessments (LSA)	July 2016
	Potential nesting habitat identification followed by horizontal and vertical radar surveys	June 2017
Raptors – northern goshawk	Reconnaissance surveys (LSA) • identifying areas of suitable habitat	August 2015
	Species-specific ground surveys (LSA) • call-playback	June and July 2016
Raptors – western screech-owl	Reconnaissance surveys (LSA) • habitat assessments	August 2015
	Species-specific ground surveys (LSA) • habitat assessments • silent listening (at common nighthawk survey locations)	2016 field visits
Non-migratory game birds – white-tailed ptarmigan	Unlimited radius point count surveys and encounter transects (LSA)	August 2015 June and July 2016
Non-migratory game birds – sooty grouse	Unlimited radius point count surveys and encounter transects (LSA)	August 2015 June and July 2016
Amphibians – western toad	Species-specific ground surveys (LSA) • presence/not detected level	August 2015 June July, and August, 2016

16.4.3.2.2 Habitat Modeling

Wildlife habitat ratings are a tool for quantifying the amount of habitat available in the pre-Project condition and the amount of habitat potentially affected by the Project. The resulting habitat suitability maps for each VC in the RSA allow use of the primary measurement indicators Habitat Availability and Habitat Distribution in the effects assessment. The primary measurement indicators allow the effects assessment to be completed under the context of the assessment endpoint, which is: "The maintenance of ecological conditions that support populations relative to existing baseline conditions." Habitat modelling allows for incorporation of pathway components that inform the assessment of potential Project effects on Wildlife. For example, the following pathway components were base information used in habitat modelling which in turn informed the effects assessments of each Wildilfe VC:

- Vegetation and Ecosystems is a pathway for all Wildlife VCs and ecosystem mapping developed for the Project was used as the base for all wildlife modeling.
- Fish is a pathway for grizzly bear and the location of fish streams was used as an input of habitat modeling for specific seasons.

Habitat suitability mapping is a product of WHRs and is defined as the ability of the habitat in its current condition to provide the life requisites of a species. Ratings indicate the value of a habitat to support a particular wildlife species for a specified habitat use compared to the best habitat in the province (the provincial benchmark). There is a provincial standard for WHRs (1999a) that was followed in the baseline studies for the Project.

One of three rating schemes were used depending on the knowledge of a given species' habitat use available at the scale and location of the RSA. A six-class scheme was used for species that had a detailed level of knowledge, a four-class scheme for species with an intermediate level of knowledge, and a two-class system for species that had limited knowledge. The level of detail required to meet objectives of the effects assessment was also considered. A two class system was used for black swift. Four- and six-class scheme habitat suitability models were completed for the remaining wildlife VCs. Habitat suitability for all VCs was modelled in the RSA, except western toad and hoary marmot which were modelled in the LSA. As described in the baseline reports (Appendix 16-A), habitat suitability was modeled for selected life requisites of each selected species.

Two mapping scales were used for the habitat suitability mapping based on ecosystem mapping completed for the Project in the LSA and the RSA. TEM was used as a basis for habitat suitability modelling in the LSA. The TEM was completed to survey intensity level 5 (reconnaissance). The TEM database was based on spatial data included within the provincial Vegetation Resource Inventory, Terrain Information Mapping and ortho-imagery and confirmed with field classifications (refer to Appendix 9-A: Ecosystems, Vegetation, Terrain, and Soils Baseline Report). PEM was used as a basis for habitat suitability modelling in the RSA. The resulting wildlife habitat suitability ratings were based on TEM in the LSA, and a combination of the TEM/PEM for the entire RSA. There are a different set of ecosystem units in the PEM versus the TEM area that correspond to the broader scale of mapping completed in the PEM.

The mapping objective in the LSA is to inform specific effects assessments and mitigation measures related to the Project footprint. This requires a higher mapping resolution than in the RSA, where the objective is to quantify the amount of high and moderately high habitat suitability as a whole. Therefore, different mapping scales were used in the LSA and the RSA and the wildlife habitat mapping outputs cannot be directly compared between the LSA and RSA models. For example, TEM ecosystem units for structural stage included each structural stage category, whereas PEM ecosystem units lumped structural stages 5 (young forest), 6 (mature forest), and 7 (old forest). Therefore, habitat ratings for wildlife species that depended on specific structural stages differed between the two models.

There were exceptions to the PEM and TEM-based habitat suitability models being the basis of effects assessments for certain species. For mountain goat, the performance of the PEM, TEM, and UWR models were assessed using comparisons to goat survey data. As a result, the PEM-based habitat suitability model was used for summer habitat across the RSA and the UWR boundaries were used for winter habitat suitability across the RSA. The provincial northern goshawk *laingi* subspecies habitat model was used to identify suitable nesting habitat for this species (Mahon et al. 2015). Only TEM models were used for western toad, hoary marmot, and bats because the effects assessment boundary was restricted to the LSA for those species considering that their home range sizes and populations were more biologically relatable to the size of the LSA than the RSA.

Selected standards employed for TEM, PEM, and habitat modelling and interpretation included:

- Northern Goshawk (*Accipiter gentilis laingi*) Habitat Models for Coastal British Columbia: Nesting and Foraging Habitat Suitability Models and Territory Analysis Model (Mahon et al. 2015);
- Standard Methods for Identifying and Ranking Nesting Habitat of Marbled Murrelets in British Columbia Using Air Photo Interpretation and Low-level Aerial Surveys (Burger 2004);
- Standard for Terrestrial Ecosystem Mapping in British Columbia (RIC 1998f);
- British Columbia Wildlife Habitat Rating Standards (RIC 1999a);
- Wildlife Habitat Rating Data Submission Standards (RISC 2004);
- British Columbia Marine Ecological Classification: Marine Ecosections and Ecounits (RISC 2002); and
- Marbled Murrelet Nesting Habitat Suitability Model for the British Columbia Coast (Mather et al. 2010).

Detailed descriptions of methods, field investigations and modeling predictions are provided in the wildlife baseline reports (Appendix 16-A).

16.4.4 Mammal Characterization

16.4.4.1 Mountain Goat

Mountain goats are widespread throughout the mountainous regions of BC. The provincial population is estimated at 41,000–66,000 goats (Shackleton 2013), which represents more than half of the world’s population (MGMT 2010). Although the species is relatively abundant within the province, it is currently ranked S3 (Special Concern (2015)) within BC due to threats throughout much of its range and declines in the southern areas of the province (BC CDC 2017). However, the Skeena region, in which the RSA and LSA are located, is estimated to support 49% of the provincial mountain goat population (16,000–35,000 goats) and the mountain goat population in this region is believed to be stable (MGMT 2010).

The RSA is located within MU 6-14 of the Skeena Region. All of MU 6-14 is managed as a General Open Season for mountain goat. Within the Bear Pass Mountain Goat Area (which overlaps the LSA and parts of the RSA) the General Open Season runs from August 1 – February 28; in the remainder of MU 6-14, the General Open Season extends from August 1 – November 15 (FLNRO 2016b). Based on records of licensed harvest in the RSA (data provided by FLNRO; K. Dixon pers. comm. 2017), between 1990 and 2015, a total of 110 goats were harvested in the RSA with an average of 4.4 goats/year (range 1 to 10 goats/year). Looking at only the most recent years, between 2010 and 2015, 37 goats were harvested in the RSA with an average of 6.2 goats per year (range 3 to 10 goats/year; Appendix 16-A). According to the FLNRO, the current level of harvest by First Nations within the region is unknown, but is believed to be low (K. Dixon pers. comm. 2017). The Nisga'a Wildlife Management Plan for 2014-2016 indicates there is very little hunting pressure directed at mountain goats, with previous average annual harvests estimated at one individual goat (Nass Wildlife Committee 2014).

Mountain goats typically inhabit alpine and subalpine habitats; however, forested habitats may also be used in some areas. All mountain goat populations are associated with steep, rugged, 'escape' terrain, which is critical for predator avoidance. Escape terrain generally consists of shear or broken cliffs or rock faces and other steep slopes ≥ 40^{o} (MGMT 2010). Mountain goats rarely venture more than 400–500 m from escape terrain, except when making long distance movements, such as seasonal range movements or excursions to mineral licks (Chadwick 1973; Poole and Heard 1998; Taylor et al. 2006). The quality of seasonal ranges is therefore dependent on the combination of forage habitat in proximity to escape terrain (MGMT 2010).

Distances among different habitat types and associated seasonal movement patterns varies widely among populations and geographic regions; seasonal habitats may be located in the same area with slight differences in elevation, or may be separated by substantial differences in elevation as well as horizontal distances of up to 35 km (Nichols 1985; Poole and Heard 1998). The winter season is typically considered the most limiting for mountain goats due to reduced forage availability, cold temperatures, and high energetic cost of travelling through deep snow (Chadwick 1973; Fox et al. 1989; Côté and Festa-Bianchet 2003; Taylor and Brunt 2007; Poole et al. 2009). In addition to requirements for escape terrain and foraging habitat, winter habitat selection is driven by factors that result in reduced snow depths. Two types of winter habitat are regularly described for mountain goats. The first is areas with steep, warm aspect slopes, at or below treeline, where the combination of aspect, lower elevation, and forest canopy reduce snow depths. The second is high elevation windblown ridges and mountain tops (Hebert and Turnbull 1977). Based on the available literature, both strategies are used in the Project region (e.g., Pollard 2002; MacLean et al. 2006; Demarchi and Johnson 1998).

Natal sites are where nannies give birth in late May and June and spend their first few days in isolation with their kids. Natal sites general occur near or within winter ranges (MGMT 2010). They are typically secluded sites, often found in rugged, inaccessible terrain.

Summer habitat includes a wider range of characteristics than winter, although proximity to escape terrain remains a key factor. Typically, mountain goats spend the summer in alpine and subalpine habitats where they forage on a variety of grasses, sedges, forbs, and shrubs (Hebert and Turnbull 1977). Goats may exhibit elevational shifts in habitat use during the summer that follows the progression of green-up (BLM 2012). Mountain goats tend to travel more frequently and over greater distances in the summer and have larger ranges than in the winter (Côté and Festa-Bianchet 2003).

Mineral licks can be important habitat features for mountain goats in many areas. The primary mineral being sought after in most areas is believed to be sodium, possibly due to low sodium content in most alpine plants (MGMT 2010); however, elevated levels of magnesium, manganese, iron, and copper have also been reported at lick sites and are known to be important mineral supplements for other ungulates (Ayotte et al. 2006; Dormaar and Walker 1996). Many interior populations of mountain goats make regular use of natural mineral licks, often travelling to low elevation sites or areas distant from their usual home ranges (Rideout 1974; Hebert and Turnbull 1977; Hopkins et al. 1992; Ayotte et al. 2008; Poole et al. 2010); however, documented use of mineral licks by mountain goats in coastal areas is unreported (MGMT 2010).

Habitat suitability mapping was completed using a 6-class rating scheme for general living within the summer (May-October) and winter (November-April) seasons (refer to Section 4.1.4 of the Wildlife Baseline Report, Appendix 16-A). The models were based on TEM within the LSA and PEM within the RSA; however, review of the models found the PEM was more reliable and therefore was used for the effects assessment analysis in both the RSA and LSA (for more details on this analysis refer to Appendix 16-A). Based on the PEM modelling there is approximately 1,910 of effective (high or moderate-high) summer living habitat in the LSA and 38,961 ha of effective summer living habitat in the RSA (Figure 16.4-1).

Analysis of the winter living habitat suitability mapping based on PEM for mountain goat showed low correlation to goat locations observed during the 2017 late winter survey (Appendix 16-A). The apparent reason for this was that the model assumed goats would primarily be using a winter strategy of moving to lower, forested elevations to avoid deep snow (Appendix 16-A). However, during the 2017 late winter survey for the Project, the majority of goats were observed using areas above the treeline on steep, snow shedding, south aspect cliffs or on wind scoured ridges. Similarly, a 2006 late winter survey of the Nass Timber Supply Area (including the RSA) found that goats were located predominantly above treeline (MacLean et. al 2006). Therefore, the analysis of Project effects used the provincially approved mountain goat Ungulate Winter Range (UWR) to assess winter habitat availability. Evaluation of the UWR across the RSA indicated that it corresponded well with March 2017 survey data and represented the range of wintering strategies that goats exhibit in coastal BC (Hebert and Turnball 1977). The UWR polygons were developed using the Nass Timber Supply Area survey data (MacLean et al. 2006) along with other regional survey data (Keim and Lele 2006) and predict mountain goat winter habitats that include both types of wintering strategies described above. Evaluation of the UWR identified approximately 2,275 ha of winter living habitat within the LSA and 14,162 ha of winter living habitat within the RSA (Figure 16.4-2).

Surveys for mountain goats within the Project LSA and RSA included various seasonal surveys conducted during Project baseline studies (Appendix 16-A) as well as previous baseline surveys (Rescan 1995) and other studies within the region conducted by NLG, the Province of British Columbia, and others. Surveys included aerial population inventories and ground-based surveys within the LSA, including habitat assessments, fixed observation stations, and wildlife cameras (Appendix 16-A).

Overall, the LSA provides habitat for mountain goat and supports a relatively high number of mountain goats, but does not appear exceptional within the RSA or the broader region. Data from eight different aerial surveys of the LSA conducted between 1990 and 2017 found between 44 and 71 goats in the Bitter Creek valley (Appendix 16-A). The 2017 survey was conducted as a total count survey (71 goats observed), and other survey totals represent a minimum count of the mountain goats in the area at the time of the survey.

Refer to Appendix 16-A for a summary of previous existing data. Although comparisons between the numbers of goats observed during surveys in different study areas is challenging, based on a simple calculation of the number of goats observed divided by the total area of the survey block, the observed numbers of goats within the LSA reflect similar densities to those reported in the Nass Wildlife Area south of the RSA (Appendix 16-A; Demarchi et al. 1997; Demarchi and Johnson 1998).

Baseline studies found mountain goats widely distributed throughout the LSA during both the summer and winter. Goats were observed on both sides of the Bitter Creek valley, but were most concentrated in the central sections of the LSA. Specifically, goats were more commonly located along the slopes west of Roosevelt Creek, on the east side of the Bitter Creek valley between Roosevelt Creek and Rio Blanco Creek, and on the west side of the Bitter Creek valley upstream of the confluence with Hartley Creek (Rescan 1995; Appendix 16-A). Most observations of goats and goat sign were at higher elevations in alpine and subalpine habitats within the LSA; however, some use was also noted at mid- to lower elevations (Appendix 16-A). Numerous goat trails have been mapped within the LSA (see Section 16.7.3.2) and wildlife camera monitoring along several of the trails in upper Bitter Creek valley recorded over 2000 detections of goats from June 5 – August 31, 2016. Two possible mineral licks have been located along upper Bitter Creek on the east side of the valley. The size, appearance, and evidence of use suggests these two features receive limited local use and are not significant mineral licks that large numbers of goats make regional movements to use.

Figure 16.4-1: Habitat Suitability Map for Mountain Goat — Summer Living

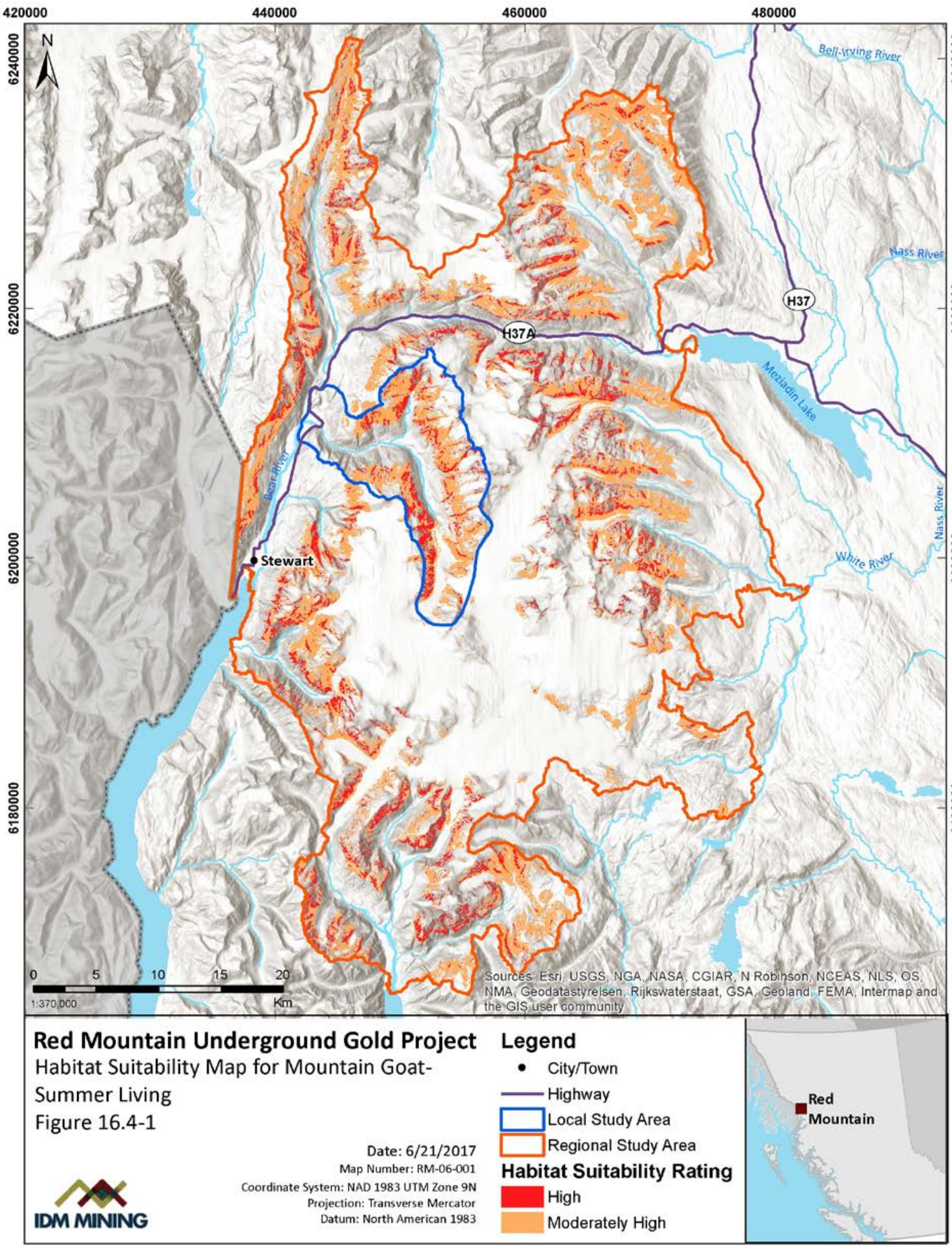
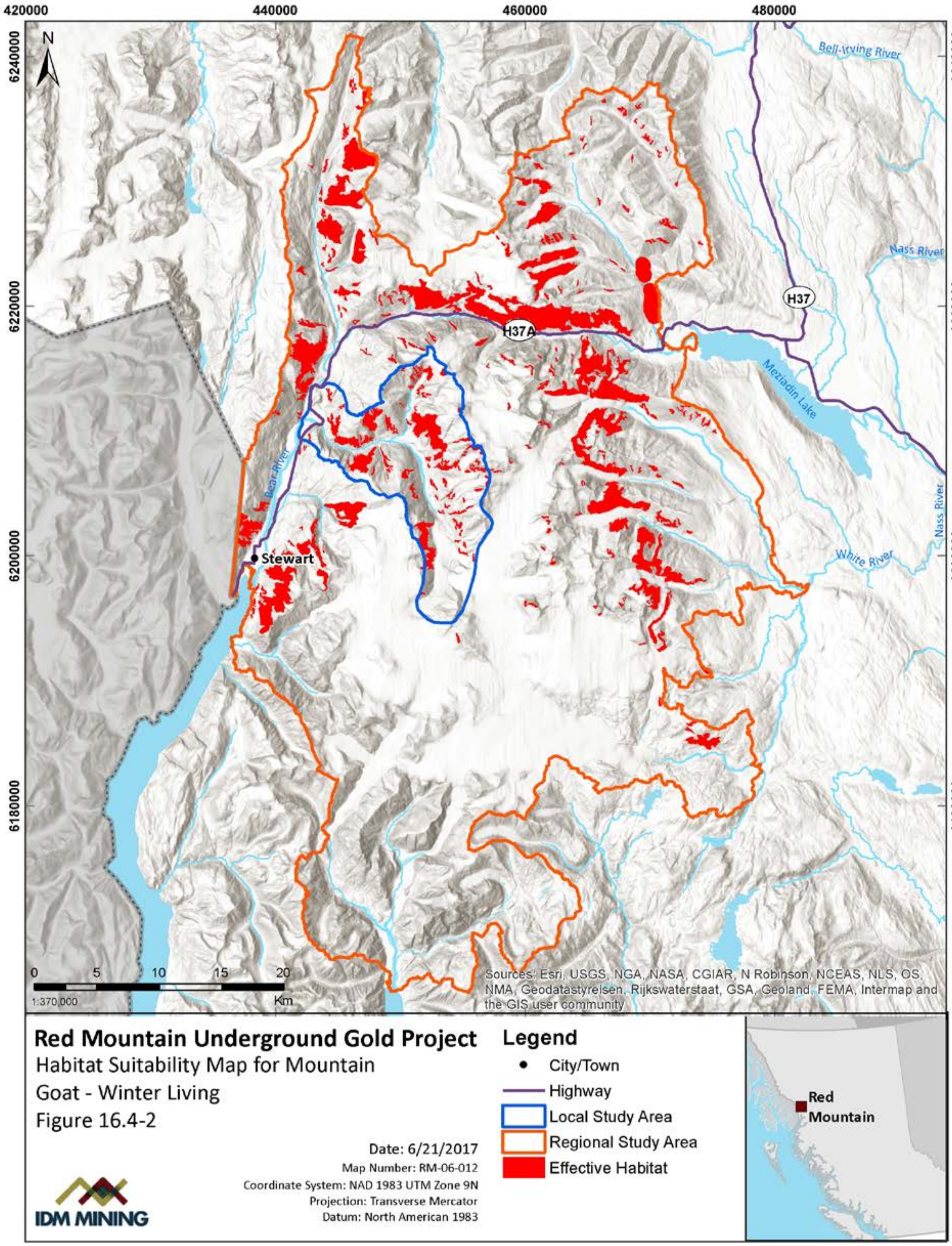


Figure 16.4-2: Habitat Suitability Map for Mountain Goat — Winter Living



16.4.4.2 Grizzly Bear

The western population of grizzly bear is considered a species of Special Concern under COSEWIC (2012a) and is blue-listed in BC (BC CDC 2017). Grizzly bears are found throughout the province and as of 2012, FLNRO (2012a) has estimated the provincial grizzly bear population at 15,000. The RSA and LSA are located within the Stewart Grizzly Bear Population Unit. The Stewart Grizzly Bear Population Unit covers 11,740 km^2, has a density ranging from 30–40 bears/1,000 km^2, contains an estimated 358 individuals, and is considered having a viable population status (FLNRO 2012a).

Grizzly bears are mostly solitary and typically have large seasonal and annual home ranges. For example, an average home range of 52 km^2 was found for adult female bears in a coastal grizzly bear population (MacHutchon et al. 1993). Coastal populations tend to have smaller home ranges than interior grizzly bears due to an abundance of high quality food and habitat found in coastal areas (Hamilton 1987; MacHutchon et al. 1993).

Grizzly bears are omnivorous and opportunistic in their feeding habitats. Grasses, herbs, roots, and berries comprise 60 to 90 percent of their diet (Bunnell and McCann 1993). Grizzly bears will also prey on other mammals depending on the season, location, and availability. Forage availability during the growing season governs habitat selection.

On the coast, beginning in the spring, grizzly bears feed on early green vegetation, such as skunk cabbage (*Lysichiton americanus*) and sedges located in the estuaries and seepage sites that become snow-free first. As the season advances, the bears follow the receding snow up the avalanche chutes feeding on emerging vegetation and roots. Ripe berries attract the bears down onto the floodplain and side-hills where they eat devil’s club (*Oplopanax horridus*), salmonberry (*Rubus spectabilis*), red raspberry (*Rubus idaeus*), black twinberry (*Lonicera involucrata*), red elderberry (*Sambucus racemosa*), and a variety of blueberries (*Vaccinium sp.*). They begin to feed on salmon as they become available in the spawning channels and continue to do so until the late fall, feeding on live and eventually dead salmon. Once salmon supplies dwindle, grizzlies return to feeding on skunk cabbage and other vegetation (MELP 1994).

Grizzly bear dens are typically located in alpine and subalpine habitats, in areas of deep soils, high snowfall and low snowmelt. Typically excavated den sites consist of steep, well-drained slopes with high density of matted vegetation that provides dense root structure to support the den roof.

Habitat suitability mapping using a 6-class rating scheme was completed for grizzly bear at the LSA and RSA levels (refer to Appendix 16-A). The suitability modeling developed for the Project identified denning habitat and feeding habitat for grizzly bear during: early spring, late spring, summer, and fall (Figure 16.4-3, Figure 16.4-4, and Figure 16.4-5, respectively).

Habitat suitability ratings identified by the models generally correlated with field ratings between 80% and 90% of the time, with the highest correlation occurring for fall feeding habitat (87.5%; Appendix 16-A). However, summer feeding habitat suitability had considerably lower correlation at 67.5% and may reflect wide ranging summer foraging opportunities within the LSA.

High or moderate early spring feeding habitat was limited to lower elevation forest and wetlands and appeared associated with riparian areas and south facing slopes. Late spring feeding habitat was expanded into higher elevations along Roosevelt Creek and Bitter Creek within the LSA. A similar distribution was evident within the RSA but also included river valleys of major watercourses such as the Bear River. Suitable summer feeding habitat was focused on upper elevations within the sub-alpine and alpine regions within the RSA and LSA. Distribution of high or moderate fall feeding habitat within the LSA was limited to lower Bitter Creek near the confluence with Bear River. Within the RSA, areas with high or moderate fall feeding habitat correlated with known salmon watershed including the Kshwan and Sutton River watersheds to the south of the LSA, the White River and Meziadin Lake to the east of the LSA, and the Bear River to the north and west of the LSA. Suitable denning habitat within the LSA and RSA was limited to higher elevations with north or northwest facing slopes.

Based on records of licensed harvest for MU 6-14 and MU 6-16 (data provided by FLNRO; K. Dixon pers. comm. 2017) between 1976 and 2015, a total of 253 grizzly bears were harvested with an average of 6.3 grizzly bears/year (range 1 to 18 grizzly bears/year). Between 2010 and 2015, 38 grizzly bears were harvested with an average of 6.3 grizzly bears per year (range 2 to 11 grizzly bears /year; data provided by FLNRO; K. Dixon pers. comm. 2017). The LSA comprises 1% of the MU 6-14 where between 1976 and 2015, a total of 77 grizzly bears were harvested and between 2010 and 2015 10 grizzly bears were harvested.

Grizzly bear opportunistic surveys were completed throughout the LSA in both 2015 and 2016 (Table 16.4-1 in Section 16.4.3.2.1). Surveys included searching for grizzly bear sign, including individuals, tracks, scat, trails, and rub or bite trees. Wildlife cameras were installed in areas where significant grizzly bear sign had been observed or where travel corridors were suspected. An aerial den survey, conducted in August 2015, focused on optimal denning habitat (i.e., steep north facing slopes at or near the tree-line).

Within the LSA, no grizzly bear dens were recorded in 2015, but five dens were located in 2016. All five dens sites were located at similar elevations (near or just above the treeline), on slopes greater than 60% with deep loose soils, and in areas of significant herb/dwarf shrub vegetation. Four of the five dens appeared to be recent (winter 2015/2016) and the fifth appeared to be older. Dens were located on the south facing slope on the western portion of watershed opposite the Access Road between Highway 37 and the Process Plant.

During the July 2016 mountain goat overview flight, three grizzly bears were observed in the RSA and one grizzly bear was noted during the August 31 overview flight. Six incidental bear signs (scat, track, or sign of excavation) were observed across the LSA. Grizzly bears were recorded 21 times on two separate wildlife cameras between June and August. The bears were photographed using trails within the MHmmp and CMAun BGC subzones during June, July, and August.

Figure 16.4-3: Habitat Suitability Map for Grizzly Bear — Late Spring Feeding

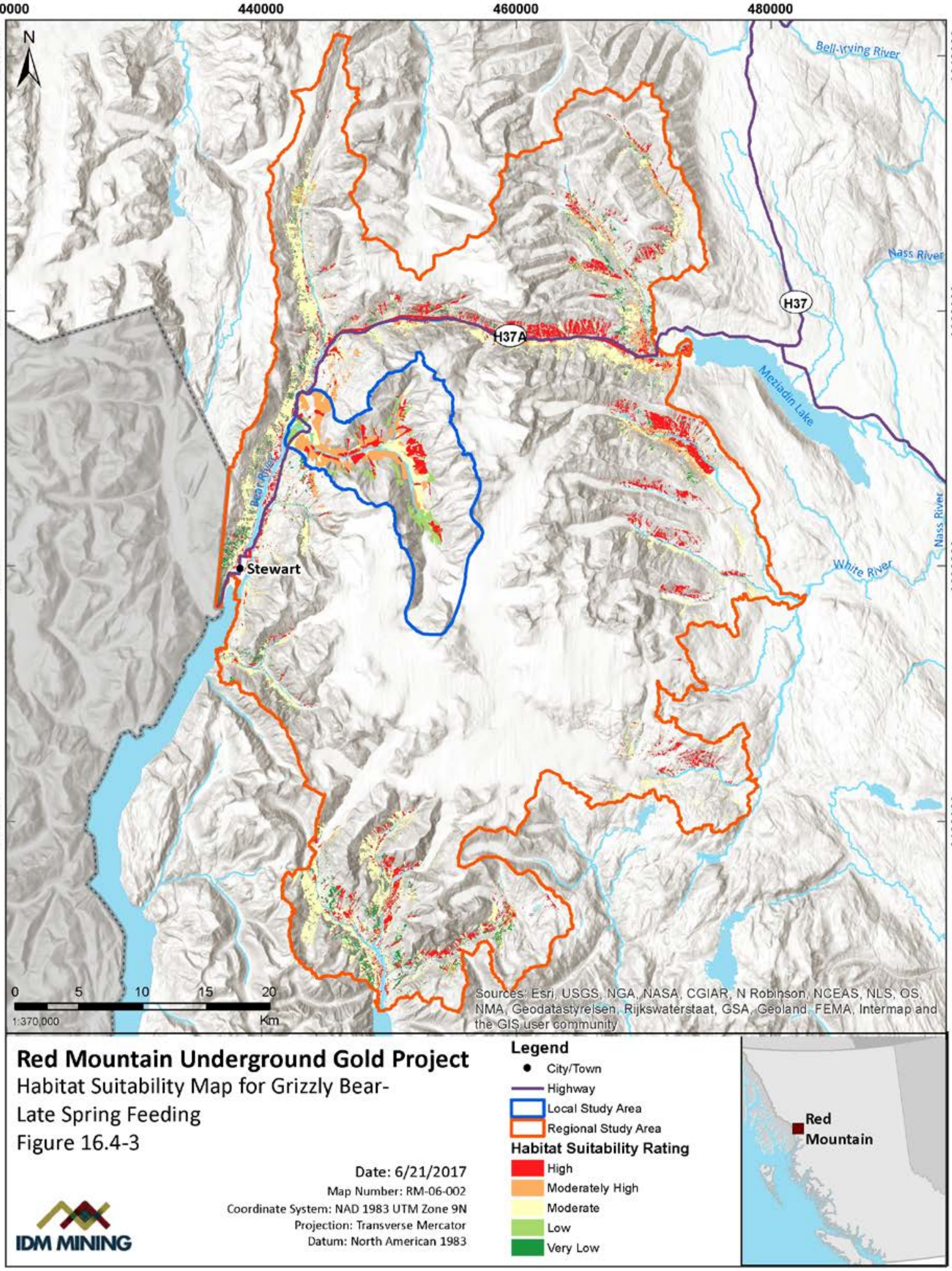


Figure 16.4-4: Habitat Suitability Map for Grizzly Bear — Summer Feeding

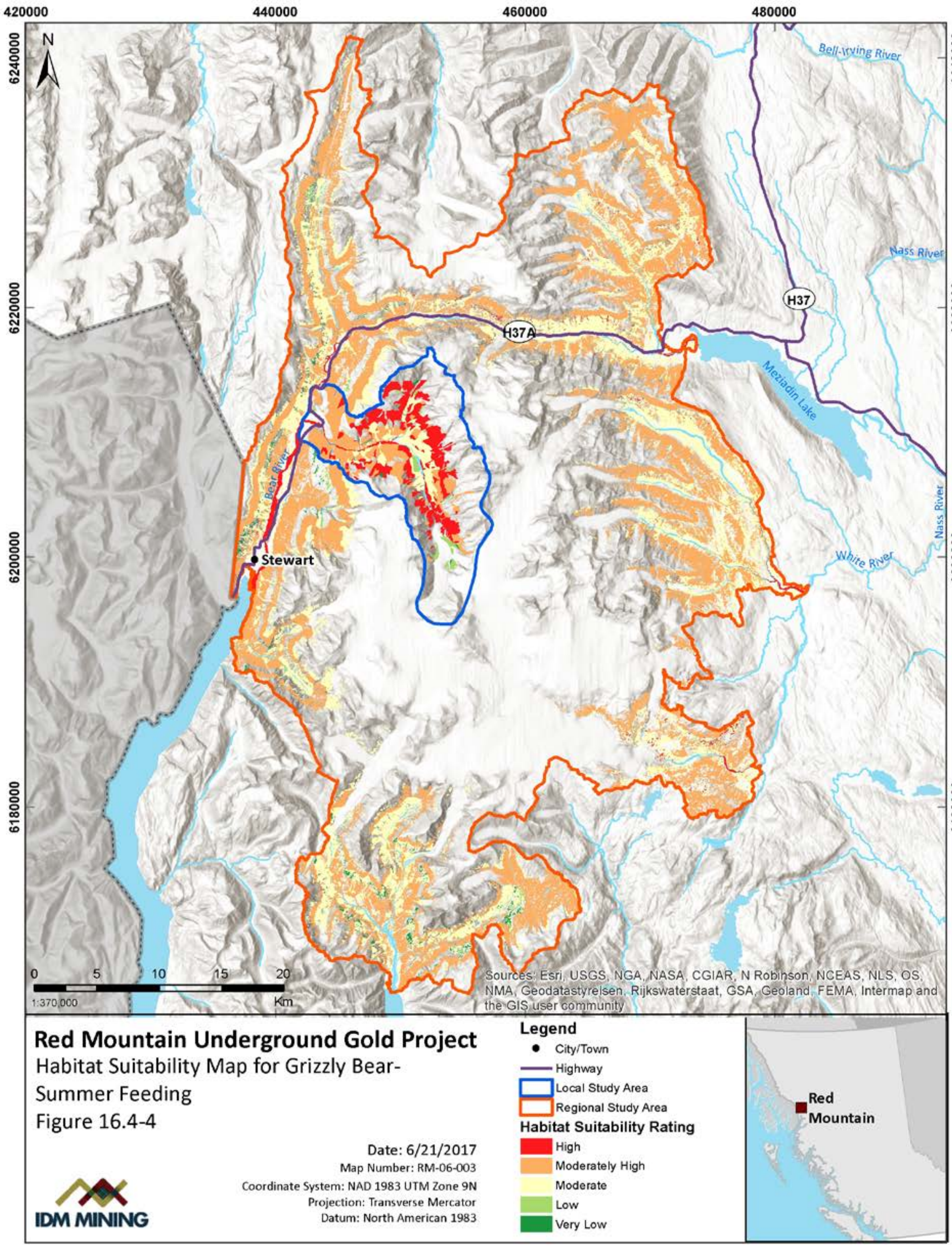
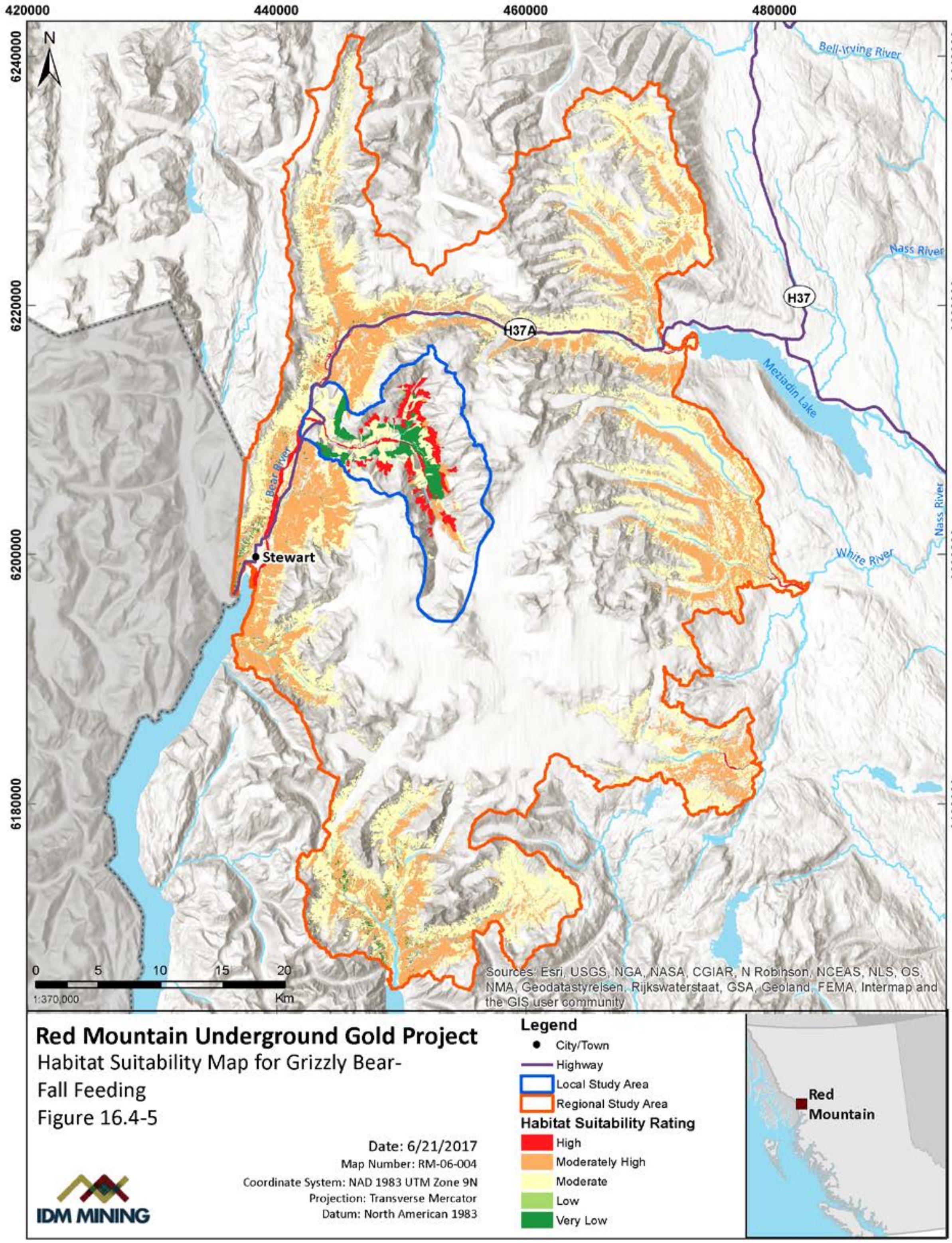


Figure 16.4-5: Habitat Suitability Map for Grizzly Bear — Fall Feeding



16.4.4.3 Moose

Moose are one of the most widely distributed ungulates in BC. They are most abundant in the central and sub-boreal interior, the northern boreal mountains, and the boreal plains of northeastern BC (Blood 2000). They are found within all BGC zones except for the Coastal Douglas-fir, Bunchgrass, and Ponderosa Pine BGC Zones (Stevens 1995).

As of 2000, the provincial moose population was estimated to be approximately 170,000 animals with over 70% of the population being located in northern BC (Blood 2000). In recent years within several areas of BC, the moose population trend is decreasing. In the Skeena Region, the Nass Wildlife Area survey results indicate a 70% population reduction from 1997 to 2011, and the Bulkley Valley Lakes District survey results indicate a 20% population reduction from 2004 (FLNRO 2012b).

Moose prefer semi-open successional stages of forest habitat with an abundance of browse (Stevens and Lofts 1988) including the sub-climax stages of forest succession, which are dominated by deciduous trees and shrubs. Heavily used areas include the floodplains of major rivers, riparian communities along smaller streams and lakes, wetlands, regenerating burns and cut blocks, and avalanche chutes (Spalding 1990; MacCracken et al. 1997). During spring and summer months, moose forage primarily on the leaves of woody plants and forage more selectively (Renecker and Hudson 1986). During winter, moose diet is composed of highly lignified woody stems.

Available winter habitat is a critical limiting factor for moose populations, with moose winter ranges generally restricted to elevations below 900 m. Moose start to move from more general habitat or from higher elevations to lower elevations once snow depths exceed 40 centimetres (cm) (Modaferri 1992; Coady 1974). Movements can be severely restricted when snow depths exceed 70 cm (Kelsall and Prescott 1971).

The size of moose home ranges vary widely. Some move to distinctly separate winter ranges, while others will live year-round in the same area. Home range sizes for non-migratory populations have been estimated at 6 to 27 km^2 during winter and 2 to 35 km^2 during summer (Petticrew and Munro 1979; Stevens and Lofts 1988).

Habitat suitability mapping using a 6-class rating scheme was completed for moose at the LSA and RSA levels (refer to Appendix 16-A for modeling methods) for summer and winter. Both the RSA and LSA provide little suitable habitat for moose throughout the year. Approximately 3% of the LSA (446 ha) and 5% of the RSA (10,076 ha) is high or moderately high suitability summer living habitat, and 1% of each the LSA (172 ha) and RSA (1,955 ha) is winter living habitat. Summer habitat was widely distributed within the LSA in isolated patches. Winter habitat for moose was clustered along the floodplains of the lower reaches of Bitter Creek near the confluence with Bear River and around the Clements Lake area. Within the RSA, winter habitat areas were located in the Nelson and Willoughby drainages and American Creek. The latter is immediately northeast of the LSA, and had high to moderately high habitat located in the floodplains near the confluence with Bear River.

Habitat suitability ratings identified by the models agreed with LSA field ratings between 75% and 85% of the time, with the highest correlation occurring for winter habitat suitability (Appendix 16-A).

Based on records of licensed harvest (data provided by FLNRO; K. Dixon pers. comm. 2017) between 1976 and 2015, a total of 979 moose were harvested in MU 6-14 and MU 6-16 with an average of 27.2 moose/year (range 7 to 76 moose/year). Looking at only the most recent years, between 2010 and 2015, 11 moose were harvested in these management units (data provided by FLNRO; K. Dixon pers. comm. 2017). The LSA comprises 1% of MU 6-14. Between 1976 and 2015 a total of 280 moose were harvested in MU 6-14 and no moose have been harvested in this area since 2011 when 11 moose were harvested. MU 6-14 and 6-16 are currently closed to moose hunting.

Field surveys for moose were focused on areas in the valley bottom near Clements Lake and the lower floodplains of Bitter Creek and the Bear River. Survey intensity was conducted at a presence/not detected level and used a combination of encounter transects and habitat plots. Searches were conducted mainly for pellet groups and browse use as well as tracks, antler rub marks, and bark stripping. Approximately 19 km of transects were surveyed specifically for moose in the valley bottom portions of the LSA. No signs of moose or evidence of use were observed during any of the surveys in 2015 or 2016.

16.4.4.4 Furbearers

16.4.4.4.1 Marten

Dawson and Cook (2012) have separated marten into two species based on molecular and morphological variation, with no notable differences between their ecology. Both species are found in BC: American marten and Pacific marten (*M. caurina*). There is potential for both species to be present within the RSA. Most of the available marten information for British Columbia does not differentiate between the two species.

In general, marten are distributed throughout forested moist regions of BC, including Haida Gwaii and Vancouver Island. Marten habitat can range from sea level to timberline, but the highest quality habitat is predominantly found at lower elevations. They are often considered an “old-forest dependent” species, but recent research has shown that it is more the physical structural of the forested stand and not its age that is of importance (Buskirk and Powell 1994; Hatler et al. 2003).

Roberts (2004) states that highly suitable marten winter habitats are mesic to hygric mature and old coniferous forests that have high levels of coarse woody debris, 20% to 60% canopy closure, few deciduous trees in stand, and some high and low shrub cover. Spruce and fir dominated habitats provide the most suitable cover types for marten. Tree stand composition of at least 40% spruce or fir provides the optimal winter habitat (Strickland and Douglas 1987). Strickland and Douglas (1987) further explain that canopy closures are optimal when greater than 50% but are acceptable between 30 to 50%.

Marten have difficulty in retaining body heat during colder temperatures due to their relative small body size. Mature coniferous forests provide the greatest winter cover with high percentage of old trees and dead trees providing denning and resting sites (Clark and

Campbell 1977). In BC, Lofroth (1993) found that marten preferred winter resting sites in forested areas, near frozen streams, and in forest/edge ecotones. Accessibility to subnivean environment is influenced by snow depth and the structure of the coarse woody debris. The amount of coarse woody debris structure available creates travel routes for marten to subnivean environment.

Marten are opportunistic predators and will feed on a variety of small mammals and birds, such as red squirrel (*Tamiasciurus hudsonicus*), red-backed vole (*Myodes* sp.), grouse, snowshoe hare (*Lepus americanus*), small birds, and other small mammals. In late summer, marten have been known to include fruits, such as wild strawberries (*Fragaria* sp.), black huckleberry (*Vaccinium membranaceum*), and raspberries, into their diet. Marten will eat carrion when it is available and can be found at ungulate kill sites.

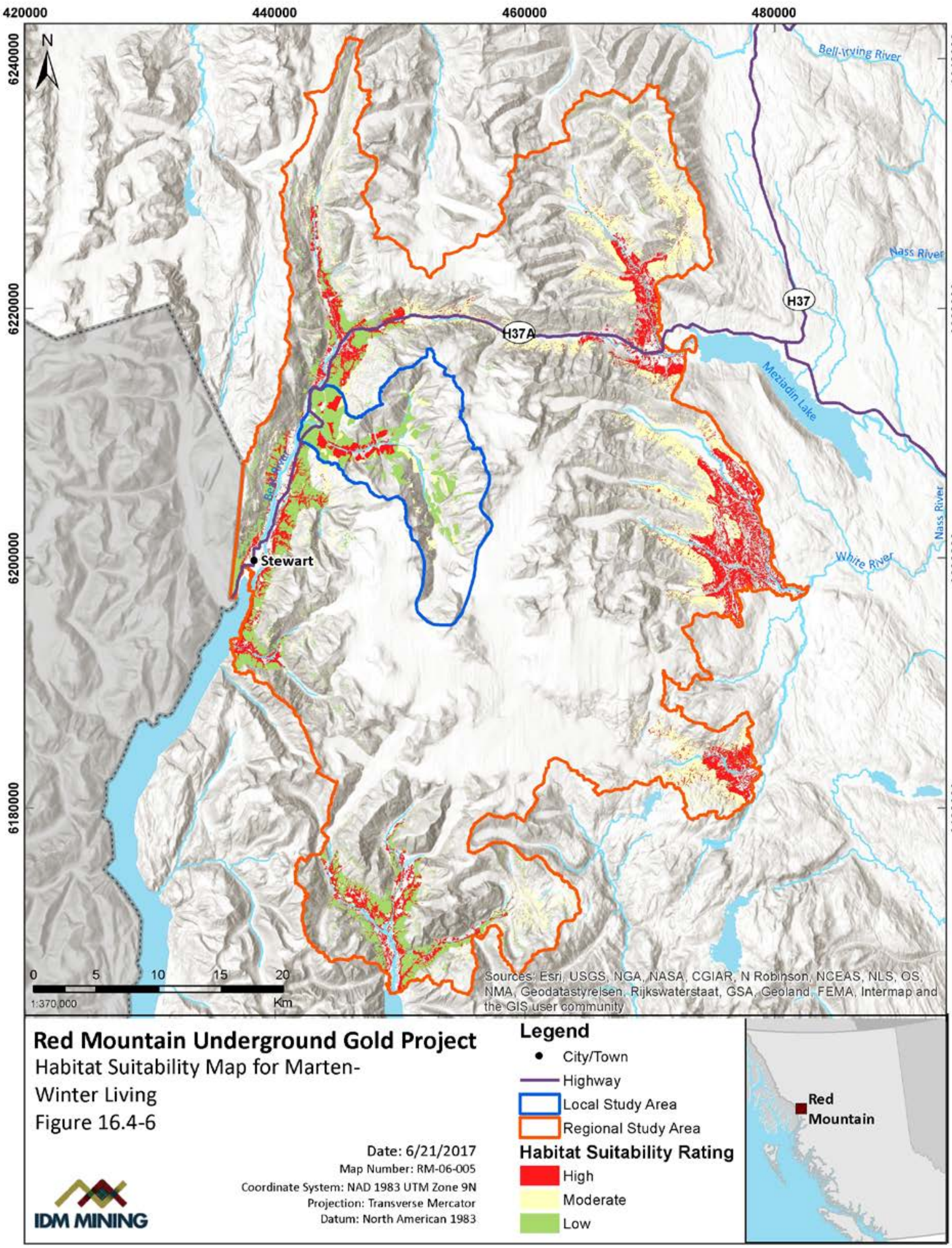
Marten are solitary except during the breeding season. Home range sizes are variable depending on geographic location, available habitat types, and prey abundance. It is estimated that in BC, marten have an average home range size of about 5 km^2 for males and 2 to 3 km^2 for females (Hatler and Beal 2003).

Habitat suitability mapping using a 4-class rating scheme was completed for marten winter living at the LSA and RSA level (refer to Appendix 16-A for modeling methodologies) (Figure 16.4-6). Winter habitat was considered the most important life requisite for marten (Watt et al. 1996). Modeling identified approximately 7% of the LSA (1,157 ha) and 10% of the RSA (21,175 ha) as having high or moderate suitability for winter living habitat. In the LSA, the majority of the high winter living habitat was located within mature and old forests along Bitter Creek.

Based on records of licensed traplines in the RSA (data provided by FLNRO; K. Dixon pers. comm. 2017), between 1985 and 2015, a total of 5,894 marten were trapped in MU 6-14 with an average of 280.7 marten/year. Between 2010 and 2015, 811 marten were trapped in the MU with an average of 135.2 marten per year (data provided by FLNRO; K. Dixon pers. comm. 2017). Based on records of licensed traplines in the LSA, between 1994 and 1999, a total of 545 marten were trapped in trapping license TR0614T101. The LSA falls entirely within this trapping license, which covers an area four times the size of the LSA. An average of 90.8 marten were trapped per year on this trapline (data provided by FLNRO; K. Dixon pers. comm. 2017).

Field verification of the habitat suitability model was conducted in the LSA and was based on structural stage identification and presence of coarse woody debris. The marten winter model predictions matched 93% of the field ratings. Opportunistic searches for marten were conducted throughout the LSA in conjunction with other ground-based wildlife surveys during 2015 and 2016. Searches included looking for potential signs including scat and tracks. No incidental observations of marten were made. Based on trapline data, it can be assumed that a viable marten population can be found within the LSA.

Figure 16.4-6: Habitat Suitability Map for Marten — Winter Living



16.4.4.4.2 Wolverine

Wolverines are a species of Special Concern under COSEWIC (2014) and are blue-listed in BC (BC CDC 2017). Increased hunter access from transportation corridors, forestry, mineral exploration, and oil and gas development is considered a threat to wolverine populations (COSEWIC 2014). Permanent, temporary, and functional habitat loss from these activities is also considered a threat to wolverine population stability (COSEWIC 2014).

In 2007, wolverine numbers in BC were estimated to range between 2,700 and 4,760 individuals (Lofroth and Krebs 2007). Lofroth and Krebs (2007) derived wolverine density estimates for various habitat ratings and calculated a mean density of 6.2/1,000 km^2 in high-quality habitat. Much of the area around Stewart is estimated at having a density of 2 wolverines/1000 km^2 (95% CI = 1.2 – 3.9; Lofroth and Krebs 2007).

Male home ranges are substantially larger (three times) than female home ranges and can overlap into many female ranges, but female ranges do not overlap into another female home range. Wolverine home ranges in the Project area are likely to be similar to those known from studies in other regions of BC where males had home ranges of 1,005 and 1,366 km^2 and females were 311 and 405 km^2 (Lofroth 2001; Krebs and Lewis 1999).

Preferred wolverine habitat is not easily defined by specific vegetation parameters but can be better defined by the distribution and abundance of food, including carrion, suitable habitat/structure for denning, and meeting points (e.g., sheltered places where kits are left during foraging periods). Wolverines use a wide assortment of structural stages, although mature and old forest structural stages are predominantly used (Lofroth and Weir, 2004). Lofroth (2001) reported that females tend to use both early successional (forest age classes 1 and 2) and late-successional (forest age classes 6 and 7) forests, while males used mostly late-successional forests. Both sexes had little use for mid-successional stands (forest age classes 3 and 4). In mountainous areas of BC, females also tend to use the Engelmann Spruce – Subalpine Fir BGC zone during winter and alpine areas during the summer. Males tend to use lower-elevation BGC zones during winter and switch to the higher-elevation Engelmann Spruce – Subalpine Fir BGC zone during the summer (Krebs and Lewis 1999; Lofroth 2001).

Den sites are probably the only small-scale habitat requirement for wolverine. Dens are important since they provide security for kits and are usually situated in close proximity to food sources. Dens are typically found in high elevation forest openings. Typically the small forest openings are less than 100 m in diameter. Female wolverines usually situate their dens in snow tunnels leading to masses of fallen trees (accumulation of Coarse Woody Debris classes 1 and 2) or rocky colluvium (Lofroth and Weir 2004). A female may reoccupy denning habitat for several consecutive years. Denning females are sensitive to disturbance, which can lead to dens being relocated or litter abandonment (COSEWIC 2014).

Wolverines are opportunistic feeders and can be considered a predator and a scavenger. During summer months they tend to eat fresh prey such as rodents, snowshoe hares, birds, and young ungulates. In winter they switch to a diet consisting mostly of cached items and carrion, such as caribou (*Rangifer tarandus*), moose, mountain sheep (*Ovis canadensis*), mountain goat, deer (*Odocoileus* sp.) and elk (*Cervus canadensis*) (COSEWIC 2014). In the

Omineca Region, moose are consumed throughout the year, but adult female wolverine with kits (young) will consume more hoary marmots in the summer; in the north Columbia Mountains, caribou and mountain goats are consumed more frequently (Lofroth 2001; Lofroth and Weir 2004).

Wolverine population sizes, growth rates, and harvest sustainability in BC was evaluated based on harvest data from 1985 to 2004 (Lofroth and Ott 2007). The Project RSA overlaps three wolverine populations units (PU): the Upper Skeena-Nass (PU 14), Stewart (PU 17) and Cranberry (PU 18), all of which had sustainable harvest rates (Lofroth and Ott 2007). In all three units the majority of wolverine harvest was the result of trapping rather than hunting. An increase in annual harvest rates of one (PU17, PU18) or four (PU14) wolverines would be considered unsustainable (Lofroth and Ott 2007).

The provincial fur harvest database contains the trapping results from registered traplines in each MU. MU 6-14 had 19 wolverines trapped along the various traplines found in the RSA (data provided by FLNRO; K. Dixon pers. comm. 2017). The LSA contains a trapline that had harvested 6 wolverines. No wolverine has been trapped on this trapline since 1999 (data provided by FLNRO; K. Dixon pers. comm. 2017).

Habitat suitability mapping was completed for wolverine at the LSA and RSA level using a 4-class rating scheme that was adapted from Lofroth and Krebs (2007) 5-class rating scheme (refer to Appendix 16-A for modeling methodologies). The suitability modeling developed for the Project identified suitable growing living habitat and winter denning habitat for wolverine (Figure 16.4-7).

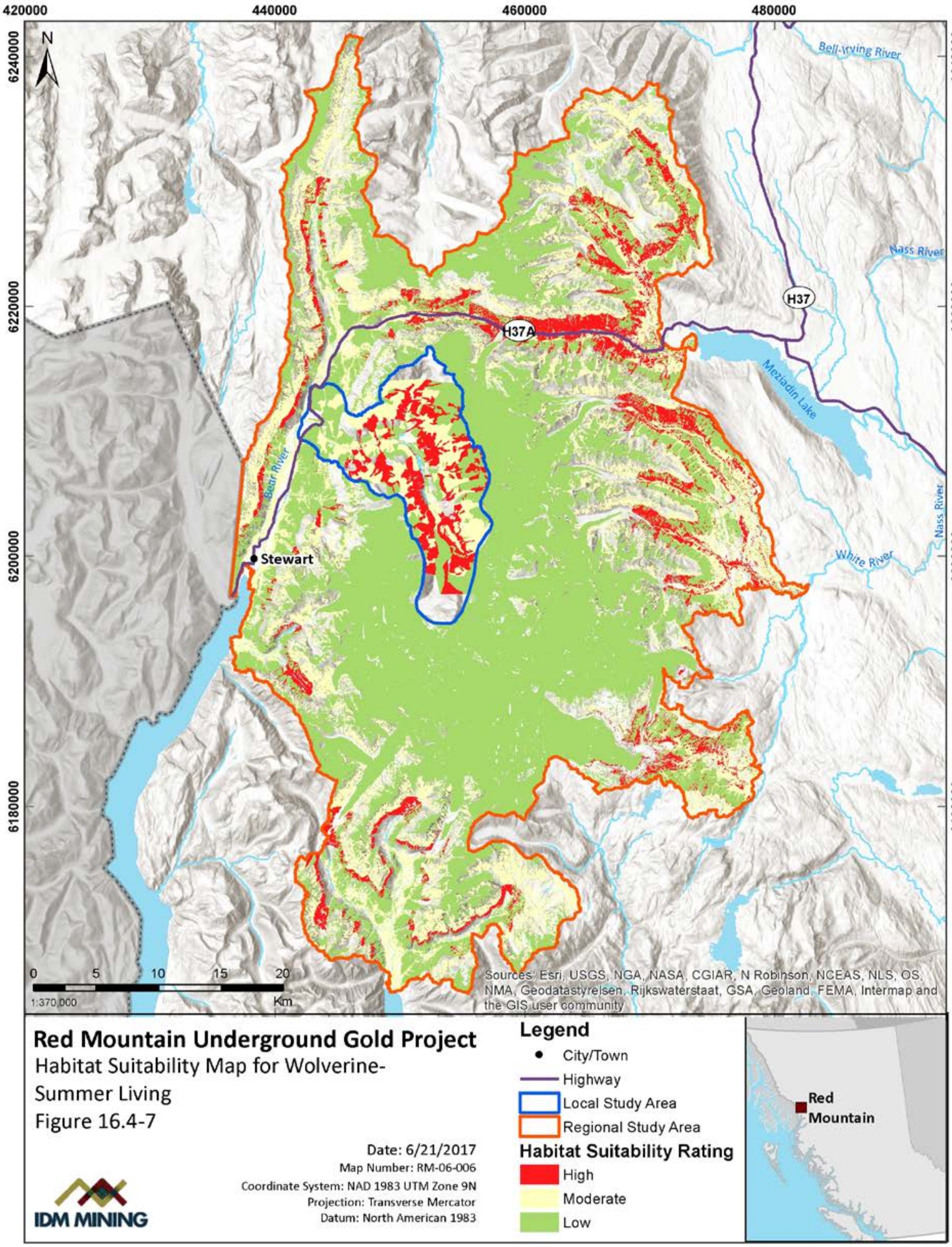
Approximately 53% of the LSA (8,457 ha) and 29% of the RSA (59,311 ha) comprise high or moderate suitability summer living habitat for wolverine. Large continuous patches of summer living habitat were identified throughout the LSA. Within the RSA, high suitability habitat was identified at higher elevations and often associated with riparian corridors, such as Strohn and Surprise creeks (north of the LSA) and major tributaries of the White River to the east of the LSA.

High or moderate suitability winter denning habitat comprises approximately 7% of the LSA (1,157 ha) and 5% of the RSA (10,906 ha). High suitability denning habitat in the RSA was primarily limited to the western boundary within Strohn and Surprise creeks and lower reaches of the major tributaries of the White River. Within the LSA, high suitability denning habitat was primarily focused within the lower reaches of Bitter Creek and to the east of Clements Lake.

The winter habitat suitability model correlated with field ratings in 90% of cases and the summer habitat suitability model correlated with field ratings in 95% of cases. Summer was closely related to prey availability and therefore closely followed the mountain goat and hoary marmot ratings.

Opportunistic searches for wolverine were conducted throughout the LSA in conjunction with other wildlife surveys during 2015 and 2016. Searches included looking for potential signs including scat and tracks. During a mountain goat survey, one potential detection (scat) was observed on benched terrain north of Goldslide Creek within moderate suitability summer living habitat (figure in Appendix 5-4 of Appendix 16-A).

Figure 16.4-7: Habitat Suitability Ratings for Wolverine — Summer Living



16.4.4.5 Hoary Marmot

Hoary marmots are the largest species of ground squirrel in BC and are found throughout most of the province. From both a global and provincial conservation status the species is considered to be widespread, abundant, and secure (BC CDC 2017).

Hoary marmots are colonial and live in social groups in alpine habitat and sub-alpine meadows, ranging in elevation from 1,250 to 2,450 masl (Nagorsen 2005). Forage typically consists of grasses, leaves, and forbs. Preferred habitat includes southern facing slopes with soft soils. Rocky or talus slopes provide vantage points to observe predators while foraging. Distances from these talus slopes to burrows are important in reducing predation risk (Holmes 1984). Hoary marmots also use burrows for daily sleeping activities, winter hibernation, and reproduction, including birthing.

Hoary marmots are generally a sedentary species. Reported home range sizes of hoary marmots are less than 14 ha and foraging ranges are less than 10 ha (Armitage 2000). Often foraging areas are located within 300 m of their burrows (RIC 1998d). Distances of nearly 1 km have been identified during juvenile dispersal of male Olympic marmots (*Marmota olympus*) from natal colonies (Griffin et al. 2009). The quality and quantity of food available influences home range size, daily movements, and population density in marmots (Armitage 2000). Food availability and predation risk influence habitat distribution in marmots (Armitage 2000; Holmes 1984). Hibernation typically occurs from September to April (Whitaker 1980).

Habitat suitability modeling using a 4-class rating scheme was conducted for hoary marmot within the LSA for summer living habitat (refer to Appendix 16-A for modeling methodologies). Denning habitat was considered to have the same habitat requirements as summer living.

Given the small home ranges and limited dispersal of hoary marmots from their denning and foraging sites, the LSA was selected as the spatial boundary of assessment for hoary marmot rather than the RSA. Therefore, no habitat modeling was conducted in the RSA for hoary marmot.

The LSA contained 684 ha (less than 5% of the total LSA) of high and moderate summer living habitat for hoary marmot. These habitats were identified in high elevation areas (more than 1,200 masl) with south-facing slopes, primarily along the eastern boundary of the LSA. Suitable summer living habitat for the hoary marmot model agreed with the field ratings in 95% of cases.

Opportunistic searches for hoary marmot were conducted throughout the LSA in conjunction with other wildlife surveys during 2015 and 2016. Searches included looking for potential signs of scat and tracks. Incidental observations were made during other surveys in 2015 and 2016 and habitat and sign were opportunistically recorded throughout subalpine to alpine elevations of the LSA. Individuals and burrows were also observed in the Goldslide Creek basin above the existing mine camp. A colony with multiple den entrances was located in the Rio Blanco Creek basin north of Goldslide Creek (Appendix 16-A).

16.4.4.6 Bats

Field data collected from 2015 and 2016 through acoustic detection and ground surveys indicated the likely presence of six bat species in the LSA: little brown myotis, California myotis, long-eared myotis, Yuma myotis, silver-haired bat, and long-legged myotis. No instances of Keen’s myotis were observed in the field surveys. The three species selected as focal species within this VC are: Keen’s myotis, little brown myotis, and northern myotis. These are representative of the possible species present in the area, represent those at risk or of concern, and have habitat requirements consistent with habitat that occurs within the study area.

16.4.4.6.1 White-nose Syndrome

There are numerous anthropogenic threats to bats which primarily consist of loss of suitable cave, mine, and mature tree roost habitat, loss of potential hibernacula habitat, and mortality from collisions with aerial arrays such as wind turbines, metrological towers, and high tension cable lines. In addition to these man-made threats, there are natural threats that affect the same bat resources, such as forest fires, climate change, avalanches, and mass wasting. In addition, White-nose Syndrome (WNS) is a species–specific threat that is affecting bats on a population level; however, it has not yet developed in BC.

Bat Conservation International has been tracking WNS since its discovery. From their website (2017): “White-nose Syndrome (WNS) is a fungal disease (*Pseudogymnoascus destructans*) that has killed millions of bats in North America since it was first discovered in a single cave in New York in 2007. The fungus thrives in low temperatures (40–55° F) and high humidity – conditions commonly found in sites where bats hibernate and grows on the skin tissues of hibernating bats, repeatedly rousing them from hibernation and causing them to consume their winter fat stores and starve to death before spring.”

The disease is causing massive population declines for multiple hibernating bat species; resulting in the most precipitous wildlife collapse of the past century. At present, WNS is found in 30 US states and 5 Canadian provinces (New Brunswick, Nova Scotia, Ontario, Prince Edward Island, and Québec) and has the risk to spread as infected bats come in contact with each other. The closest detection to BC has been in Washington State in 2016.

As a result of the high risk to bat populations, the federal government issued an emergency listing of three species that are currently affected by WNS (Northern Long-eared Bats [northern myotis], Little Brown Bat, and Tricolored Bat) under the *Species at Risk Act* in 2014. As a result of this fungal disease along with other pressures on bats, the threat is high when this spreads to BC.

16.4.4.6.2 Keen’s Myotis

Keen’s myotis is a small, long-eared, dark brown bat with light brown or buff ventral fur, and dark shoulder patches (Eder and Pattie 2001; COSEWIC 2003). The range of the long-eared myotis is not documented extending as far north as the study area. In BC, Keen’s myotis is limited to the temperate coastal rainforests, west of the Coast Mountains, including Haida Gwaii and Vancouver Island (COSEWIC 2003). There are no mapped occurrences of Keen’s myotis in close proximity to the study area. The nearest mapped occurrence is near

Hazelton (BC MOE 2008). This species is known to occupy the CWH and MH BGC zones, both of which occur within the study area (BC CDC 2017). Keen’s myotis has been recorded as occurring in caves between 4 m to 945 masl, with the higher elevation caves being used as hibernacula (COSEWIC 2003).

16.4.4.6.3 Little Brown Myotis

Little brown myotis is a medium-sized bat species. The little brown myotis occurs throughout a various range of habitats, including arid grassland, ponderosa pine (*Pinus ponderosa*), humid coastal, and northern forest ecosystems. The species range is thought to extend as far north as the treeline, and can be found throughout the mainland of BC as well as on several islands, including Vancouver Island and Haida Gwaii (Nagorsen and Brigham 1993 in Klinkenberg 2014).

Specific occurrences of the little brown myotis within close proximity to the Bitter Creek valley are not mapped; however, this species is known to reside throughout most of BC, including within BGC zones located within the study area. Additionally, presence has been confirmed through field observation within the study area.

16.4.4.6.4 Northern Myotis

The northern myotis is a small to medium–sized bat. Currently, there is no available data on population size of this species in British Columbia. Based on known occurences, the Provincial range for this species includes the southern Columbia Mountains in southeastern BC through central BC, the Peace River region, northeastern BC as far north as the Yukon Border, and there have been recent captures of this species in the Hazelton-Skeena region which suggests that the range extends into the Coast Mountains. In BC, this species typically roosts were there are mature trees within forests with a high closed canopy and within deep cracks or crevices on the trunks.

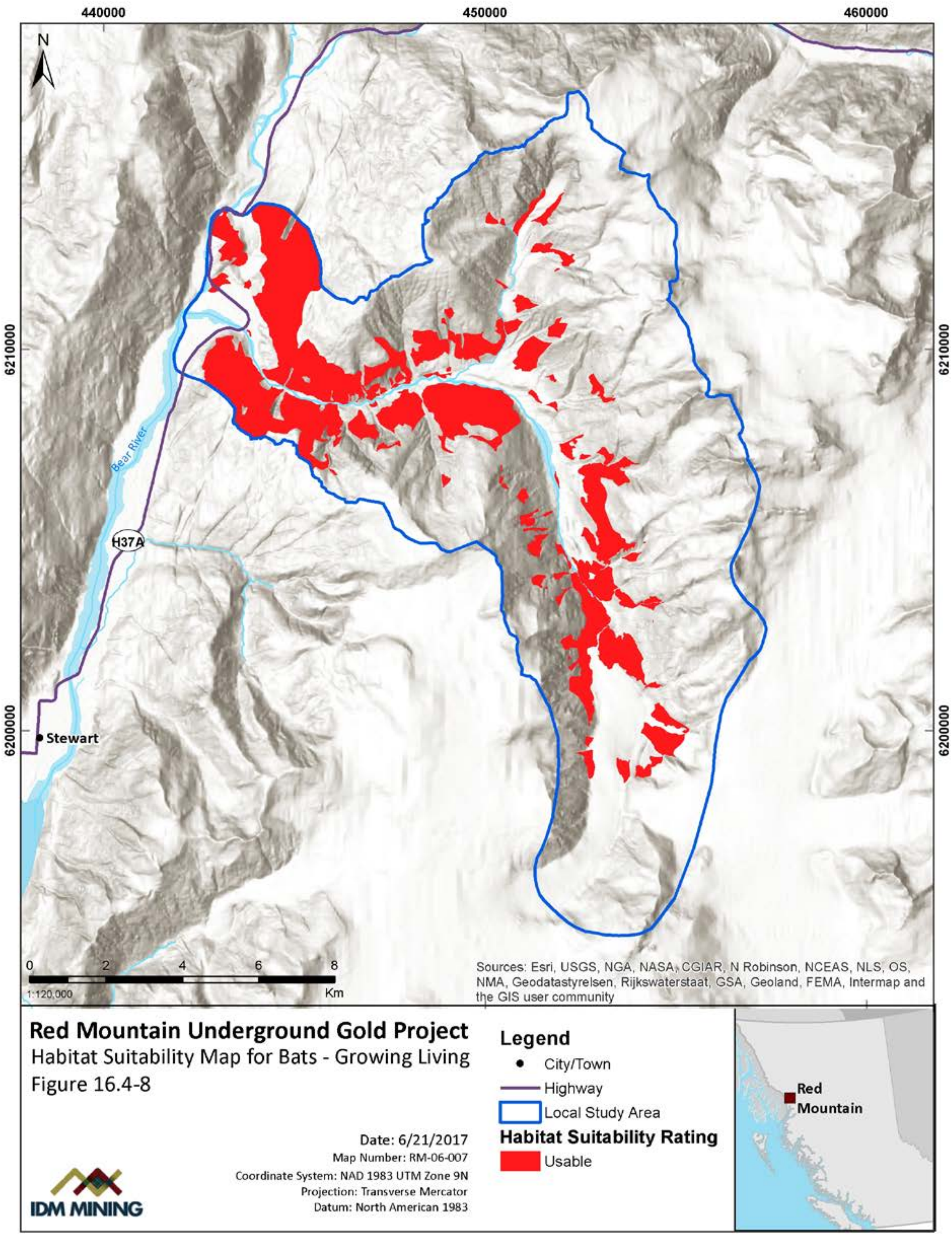
Specific occurrences of the northern myotis within close proximity to the Bitter Creek valley are not mapped; however, this species is known to reside throughout most of BC, including within BGC zones located within the study area, so it has been included.

16.4.4.6.5 Habitat Modelling

Due to the home range and movements of these species (e.g., Keen’s myotis individuals were documented travelling a typical 1 km away from their capture site (BC CDC 2017)), the LSA was used as the spatial boundary for the effects assessment. Habitat suitability mapping was completed for bats in the LSA. Habitat suitability mapping was completed for bats as a combined group since their individual habitat is largely similar and overlapping, life requisites are the same, and all three species were considered resident species, hibernating in BC (Figure 16.4-8). Modeling identified suitable living habitat for bats in summer using a two-class rating scheme (Appendix 16-A).

Approximately 18% of the total LSA (2,893 ha) contains usable summer living habitat. This habitat is considered favorable for foraging, daytime roosting, and maternal roosting. Mature and old conifer forests near moist areas below 600 masl along waterways have been identified as suitable summer living bat habitat, providing a combination of roosting and open foraging spots (i.e., abundant insect prey). In general, large diameter trees and snags are important for these bat species, since cavities and areas underneath rugged bark can provide roosting areas. The most important habitat features for bats are cave-based hibernacula; therefore cliff, talus, escape terrain, and rock outcrop habitats are also included as usable.

Figure 16.4-8: Habitat Suitability Map for Bats — Usable



16.4.5 Bird Characterization

16.4.5.1 Migratory Breeding Birds

16.4.5.1.1 Habitat Guilds

Habitat guilds were used to group species of migratory birds that are known to occur in the RSA, with the exception of species covered by species-specific habitat suitability mapping, including MacGillivray's warbler, common nighthawk, marbled murrelet, sooty grouse, and black swift (Appendix 16-A). The guilds included alpine, riparian, old/mature forest, and shrub/early successional. Species were placed into guilds based on known nesting habitat associations. These guild associations are intended to represent dominant habitat associations; it is recognized that many, perhaps most, species also depend on other habitat types for foraging or other life requisites. Species that are generalists or do not have well defined nesting habitat associations were not categorized according to habitat guilds. As a result of this categorization, 2 species were placed into the alpine guild, 14 into the old/mature forest guild, 6 into the riparian guild, and 4 into the shrub/early successional guild (Table 16.4-2). One species was associated with other habitat not represented by these guilds and seven species were considered generalists (Appendix 16-A).

Table 16.4-2: Migratory Breeding Bird Species in Associated Habitat Guilds

Common Name	Scientific Name
Alpine Species	
American Pipit	*Anthus rubescens*
Horned Lark	*Eremophila alpestris*
Generalist Species	
American Robin	*Turdus migratorius*
Dark-Eyed Junco	*Junco hyemalis*
Red-Tailed Hawk	*Buteo jamaicensis*
Rufous Hummingbird	*Selasphorus rufus*
Song Sparrow	*Melospiza melodia*
Warbling Vireo	*Vireo gilvus*
Yellow-Rumped Warbler	*Setophaga coronata*
Old/Mature Forest Species	
Chestnut-Backed Chickadee	*Poecile rufescens*
Golden-Crowned Kinglet	*Regulus satrapa*
Hairy Woodpecker	*Picoides villosus*
Hammond's Flycatcher	*Empidonax hammondii*
Hermit Thrush	*Catharus guttatus*
Pacific Wren	*Troglodytes pacificus*

Common Name	Scientific Name
Pacific-Slope Flycatcher	*Empidonax dificilis*
Red-Breasted Sapsucker	*Sphyrapicus ruber*
Ruby-Crowned Kinglet	*Regulus calendula*
Steller's Jay	*Cyanocitta stellleri*
Swainson's Thrush	*Catharus ustulatus*
Townsend's Warbler	*Setophaga townsendi*
Varied Thrush	*Ixoreus naevius*
Western Tanager	*Piranga ludoviciana*
Riparian Species	
American Redstart	*Setophaga ruticalla*
Cassin's Vireo	*Vireo cassinii*
Red-Eyed Vireo	*Vireo olivaceus*
Spotted Sandpiper	*Actitis macularis*
Wilson's Warbler	*Cardellina pusilla*
Yellow Warbler	*Setophaga petechia*
Shrub/Early Successional Species	
Lincoln's Sparrow	*Melospiza lincolnii*
Nashville Warbler	*Oreothlypis ruficapilla*
Orange Crowned Warbler	*Oreothlypis celata*
Savannah Sparrow	*Passerculus sandwichensis*
Other Species	
Common Yellowthroat	*Geothlypis trichas*

The year-round use patterns of migratory breeding birds are as follows. In general, migratory breeding birds are summer residents in northern BC; the first spring migrants arrive in late March. Breeding can occur from early April through mid-August, and birds start to head back to their wintering grounds by the end of August. Nest sites can be found from sea level up to alpine areas and is dependent on species.

Habitat suitability models with a 2-class rating scheme were developed for each migratory breeding bird habitat guild within the LSA and RSA using reproducing life requisites (refer to Appendix 16-A for modeling methodologies).

Within the LSA and RSA respectively, suitable rated nesting habitat for migratory bird guilds occurred over 39% and 17% for alpine, 21% and 17% for old/mature forest, 18% and 24% for riparian, and 9% and 6% for shrub/early successional. Overall a higher proportion of habitat rated as suitable for migratory bird nesting occurred in the LSA (87%) compared to the RSA (64%; Appendix 16-A).

16.4.5.1.2 MacGillivray's Warbler

MacGillivray's warbler is not listed federally or provincially in BC. It is identified as a priority species in Bird Conservation Region (BCR) 5 (EC 2013). It is a small songbird that breeds throughout most of the Pacific Northwest and the Rocky Mountains and winters in Central America (Pitocchelli 2013). Average population trends for bird species that winter in Central America indicate that populations have steadily decreased between 1970 and 2010 (i.e., average percent change of -8.8% between 1970 and 2010), with MacGillivray's warbler identified as experiencing a noticeable population decrease (ECCC 2016h). The main threats to birds in BCR 5 include: habitat loss and degradation due to forest harvesting and commercial/residential development, climate change and extreme weather events, pollution (e.g., oil spills), and problematic invasive non-native species that may prey on birds or displace them from their nesting habitat (EC 2013).

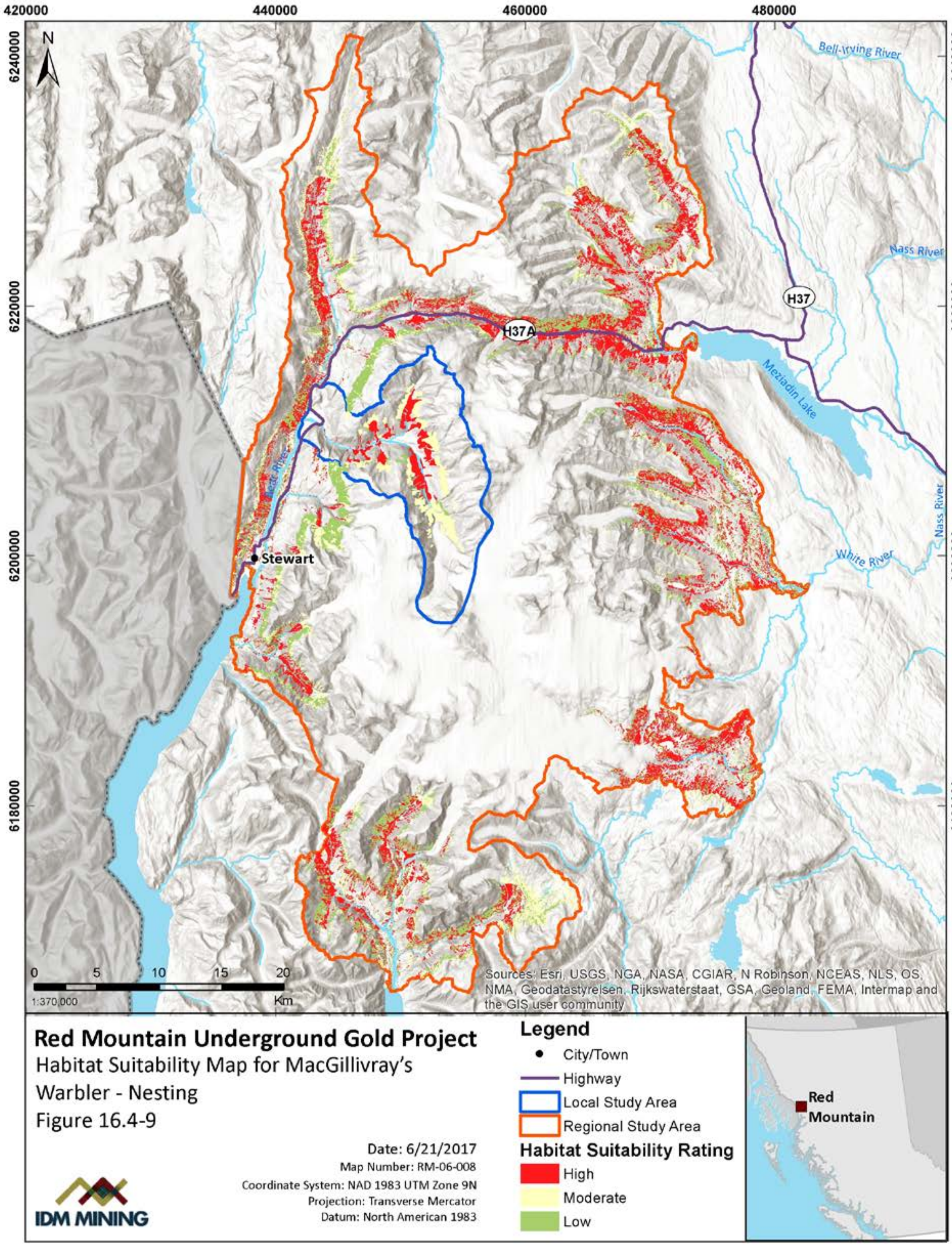
MacGillivray's warblers are summer residents in northern BC; the first spring migrants arrive in mid-May. Breeding occurs from mid-May to late July, and birds head back to their wintering grounds by late August. Nesting habitat for MacGillivray's warbler is most often associated with disturbed second growth and riparian vegetation composed of low, dense undergrowth, shady thickets, shrubs, willows (*Salix* sp.), and saplings of various tree species. Preferred habitats are often in or near riparian areas in mixed conifer forest, stream bottoms, brushy hillsides along canyons, logged areas with small remnant forest patches, burned areas, and areas recovering from avalanches with dead and fallen trees. Nest sites can be found from sea level up to 1,500 masl on the coast (Appendix 16-A).

Habitat suitability models with a 4-class rating scheme were developed for MacGillivray's warbler using living and reproducing life requisites (refer to Appendix 16-A for modeling methodologies). Attributes of suitable living habitat included dense thickets with high insect forage (i.e., structural stage 3-5). Attributes of suitable nesting habitat included riparian habitat, stream bottoms, brushy hillsides along canyons, logged-over clear-cuts with second growth, and areas recovering from avalanches with dense understory vegetation (i.e., structural stage 3-5) (Figure 16.4-9). Habitat suitability ratings identified by the LSA model agreed with field ratings in 90% of the cases (Appendix 16-A).

The habitat suitability model identified 14% of the LSA (2,258 ha) and 12% of the RSA (23,805 ha) as high or moderate suitability habitat for MacGillivray's warbler. High suitability nesting habitat in the LSA was focused within mid-elevations along the major riparian corridors of Bitter and Roosevelt creeks.

MacGillivray's warbler was inventoried during breeding bird surveys in the LSA between June 4 and July 10, 2016, using unlimited radius point count methods following provincial and federal standards. Point count stations were stratified by BGC zone and structural stage in order to obtain representative samples from each habitat type across the LSA. A total of 61 point count stations were surveyed; approximately 38% of these stations were located in suitable habitat for MacGillivray's warbler. Seven singing males were detected at six point count stations. All six stations were located within the MHmm1 subzone, and six out of the seven detections were made within habitat identified as high suitability for MacGillivray's warbler (Appendix 16-A).

Figure 16.4-9: Habitat Suitability Map for MacGillivray's Warbler — Nesting



16.4.5.2 Migratory Birds Species at Risk

16.4.5.2.1 Black Swift

Black swift is considered Endangered under COSEWIC due to a large population decline over recent decades (COSEWIC 2015) and are blue-listed in BC (BC CDC 2017). The causes of this population decline are poorly understood, but the most important threats are believed to be linked to airborne pollution (i.e., pesticides) and climate change and extreme weather events (COSEWIC 2015). Black swift is also identified as a priority species in BCR 5 (EC 2013).

Black swifts are summer residents in northern BC. The first spring migrants arrive in mid-May (Campbell et al. 1990). Breeding occurs from late June to early September. Birds head back to their wintering grounds by mid-September (Campbell et al. 1990). Nesting habitat for black swift includes steep canyon walls and cliff faces typically near or behind waterfalls (Campbell et al. 1990). Nest sites can be found from sea level up to 2,600 masl (Campbell et al. 1990).

A habitat suitability model with a 2-class rating scheme was developed for black swift within the LSA and RSA using reproducing life requisites (Black Swift Baseline 2017; Appendix 16-A). Attributes of suitable nesting habitat included cliffs or rock outcrops near waterfalls, as flowing water, high relief, high ambient humidity, darkness, and inaccessibility to predators are key habitat requirements. Within the habitat suitability model, cliff and rock outcrop ecosystems within 30 m of streams in all BGC zones, with the exception of alpine zones (i.e., CMAun and CMAunp BGC subzones), were assumed to encompass areas with potential for waterfalls and thus were considered suitable habitat.

The habitat suitability model identified that approximately 1% of the LSA (263 ha) and 1% of the RSA (2,084 ha) is suitable habitat for black swift (Appendix 16-A).

This species was detected incidentally at three different locations (Appendix 16-A). Ten individuals were detected within the LSA along Highway 37A, approximately 280 m north of the Bitter Creek Bridge on June 5, 2016, and two individuals were detected at this same location on July 4, 2016. One individual was also detected outside the LSA along Highway 37A approximately 6 km south of the Bitter Creek Bridge on June 5, 2016. One other observation of two individuals was made along the middle reaches of Bitter Creek during the general breeding bird surveys.

16.4.5.2.2 Common Nighthawk

Common nighthawk is listed as Threatened on Schedule 1 of the SARA due to short-term and long-term population declines across their range (EC 2016a). These population declines have not yet been linked to any specific threats, but potential threats include natural system modifications (e.g., reduced availability of insect prey and forest fire suppression), habitat loss and degradation, accidental mortality (e.g., collisions with vehicles, aircraft, and man-made structures), climate change and extreme weather events, pollution (e.g., pesticides, mercury, and acid precipitation), and problematic native and invasive non-native species that may prey on nighthawks or displace them from their nesting habitat (EC 2016a). Common nighthawk has been identified as a priority species in BCR 5 (EC 2013). Critical habitat has not yet been defined for this species.

Common nighthawks are summer residents in northern BC. The first spring migrants arrive in late May, breeding occurs from early June to mid-August, and birds head back to their wintering grounds by mid-September. Nesting habitat for common nighthawk can be found in almost any open or semi-open habitat where flying insects are common, such as cultivated fields, rangeland, marshes, sloughs, estuaries, subalpine habitats, and alpine habitats. Nest sites can be found from sea level up to 1,250 masl with the majority occurring between 400 and 1,000 masl (Appendix 16-A).

A habitat suitability model with a 4-class rating scheme was developed for common nighthawk within the LSA and RSA using the reproducing life requisite (Appendix 16-A). Attributes of suitable nesting habitat included open habitat with bare surfaces or gravel roofs (i.e., structural stage 1-3). Overall suitability of nesting habitat for common nighthawk within the LSA is relatively low (i.e., less than 1% of the LSA; 99 ha) with small patches located sporadically at elevations below approximately 1,300 masl in the CWHwm BGC subzone. The RSA provided a similar representation of nesting habitat (i.e., 2% of the RSA; 4,823 ha) located sporadically throughout valley bottoms at lower elevations in the CWH, MH, and ICH BGC zones.

Habitat suitability ratings identified by the LSA model agreed with habitat suitability field ratings in 95% of the cases (Appendix 16-A).

Common nighthawk inventories were conducted on June 5 and 7, 2016, and again on July 4, 2016, using a combination of silent listening and call-playback inventory methods following federal and provincial standards. Inventories were conducted at a presence/not detected level of intensity within the LSA and along sections of Highway 37A outside of the LSA. Two nighthawks were detected at one survey station along Highway 37A on June 7, 2016, and one nighthawk was detected at an adjacent survey station along Highway 37A on July 4, 2016 (both outside of the LSA). Automated Recording Units were deployed between June 6 and July 10, 2016, at three locations in the Goldslide Creek basin within the LSA; none of these detected any nighthawk activity (Appendix 16-A).

16.4.5.2.3 Marbled Murrelet

Marbled murrelet is listed as Threatened on Schedule 1 of the SARA due to past and current loss of old-growth forest nesting habitat (EC 2014a), and is blue-listed in BC (BC CDC 2017). They are identified as a priority species in BCR 5 (EC 2013). The main terrestrial threats to marbled murrelet include loss of old forest nesting habitat and fragmentation of old forest nesting habitat leading to habitat degradation and increased predation risk (EC 2014a). Marbled murrelet nesting habitat is primarily lost via forestry operations; however, urbanization and agriculture may also contribute to habitat loss in some regions. Energy infrastructure (e.g., run-of-river hydro projects, wind farms, and transmission lines) may also contribute to habitat loss and fragmentation and lead to an increase in collision and predation risks.

Critical habitat for marbled murrelet has been identified (EC 2014a) as the suitable nesting habitat defined by the marbled murrelet Nesting Habitat Suitability Model for the British Columbia Coast (i.e., BC Model; Mather et al. 2010). The Project is located within the Northern Mainland Coast conservation region for marbled murrelet, which has a minimum habitat retention level of 292,651 ha or 68% of baseline suitable nesting habitat available in 2002 (i.e., 430,369 ha) (EC 2014a). As of 2011, there were 420,221 ha of suitable nesting habitat within the Northern Mainland Coast conservation region; therefore, 127,570 ha of the 2011 habitat are in excess of the minimum habitat retention level (EC 2014a). Suitable modelled nesting habitat is located within the RSA (i.e., 4,842 ha) and one small, modelled patch is located within the LSA (i.e., approximately 1 ha). The suitable nesting habitat identified by the BC Model within the LSA was field-verified as unsuitable nesting habitat. The primary limitation of the BC Model is that it is based upon coarser base mapping and is intended for estimates of regional, not site-specific, habitat availability. Subsequent habitat modeling conducted to assess potential effects used a finer base mapping and did not identify this small patch within the LSA as suitable nesting habitat for marbled murrelet.

A habitat suitability model was developed for marbled murrelet reproducing life requisite within the LSA and RSA, which follows the BC Model criteria and uses a 6-class rating scheme adapted from Burger (2004) (Appendix 16-A). Attributes of suitable nesting habitat included old forest with multi-layered canopy providing gaps and tall trees for nest platforms. Overall suitable nesting habitat for marbled murrelet within the LSA is relatively low (1% of the LSA; 162 ha) and limited to mature forests within the lower reaches of Bitter Creek. Using the BC Model, 1% of the RSA was identified as suitable nesting habitat. The suitable habitat areas of the RSA were distributed along the western and southern boundaries.

Low-level aerial assessments following protocols outlined in Burger et al. (2004) were conducted to confirm habitat model predictions. Aerial and ground surveys identified additional high and moderate habitat suitability for nesting not previously identified within the BC Model (162 ha or 1% of the LSA). These areas, within the lower reaches of Bitter Creek, had several larger patches of structural stage 7 (old forest) Sitka spruce stands along the floodplain that provided suitable nesting platforms. Ground searches following a concentric circle pattern were conducted in these areas but no evidence of nesting activity was observed.

Radar surveys were conducted in June 2017. In preparation for the radar surveys, layers of TEM and VRI were used to map geographic locations of potentially suitable marbled murrelet nesting habitat in the Bitter Creek watershed. Potential habitat was visually assessed from low level flight to confirm radar observation locations. Radar survey methods followed Province of British Columbia Resources Information Standards Committee (RISC 2006) protocol. Vertical radar surveys, not described in the standards, followed provisional methods developed by B.K. Schroeder Consulting with guidance from Stumpf et al. (2011).

Marbled murrelet radar surveys were conducted at two locations near the entrance to Bitter Creek valley, one location six kilometres up Bitter Creek and another six kilometres downstream along Bear River. The objective was to characterize commuting behaviours and flight heights using horizontal and vertically-oriented ornithological radar systems. Two survey types (i.e., horizontal radar and vertical radar) were used to assess marbled murrelet presence and use of the area.

Four dawn radar surveys were completed concurrently at each observation location to characterize marbled murrelet abundance, flight paths, and flight heights. In horizontal orientation, the radar can detect birds in a roughly 1.5 km radius viewscape to measure flight patterns and ground speeds and aid interpretation of vertical observations.

Surveys were conducted from June 20 to June 24, 2017, which is within the core nesting period (May 1 to August 5) identified by the Pacific Seabird Group for the British Columbia region (Evans Mack et al. 2003). Radar observations were made during the near dawn activity period for marbled murrelets from 120 minutes before, to 60 minutes after sunrise. This period encompasses the known peak of daily murrelet activity (Cooper et al. 1996, Burger 1997).

Total marbled murrelet detections per dawn survey ranged from 0 to 35, combining incoming and outgoing behaviours. Pre-sunrise incoming counts ranged from 0 to 23 per survey. Mean flight heights during dawn surveys ranged from 458 m to 409 m and 903 m during the three surveys in Bear River. In the nearest long-term population monitoring location at Kwinamass River, which is located within 30 km of the mouth of Observatory Inlet and nearer to open ocean, dawn incoming counts of 559 to 1713 murrelets have been observed (Bertram et al. 2015), which are some of the highest counts on the BC coast.

The work conducted in the Bear River and Bitter Creek valleys in 2017 shows relatively low numbers of marbled murrelets flying into this watershed. Movement of murrelets appeared to be associated mostly within the Bear River valley. The low numbers of nesting marbled murrelets in this area are likely a function of distance to open ocean, as Portland Canal at the Bear River estuary extends 150 km south to its mouth. Marbled murrelet habitat in the Bitter Creek watershed occurs in small patches near the valley bottom with some connecting patches of moderate value habitat extending up the lower slopes. The upstream half of the Bitter Creek watershed appears to contain little or no potential marbled murrelet nesting habitat. The highest potential for interaction between the species and the Project is in the lower reaches of Bitter Creek where new disturbance associated with the Project is minimal.

This existing information informs the effects assessment and mitigation meaures specifically applicable to marbled murrelet. Specific recommendations include avoiding clearing during the core marbled murrelet nesting season (May 1 – August 5) or avoiding areas of moderate and higher ranked habitat particularly in riparian and/or productive patches that may contain a higher proportion of favourable nesting attributes; maintaining existing habitat conditions and natural vegetation next to Project facilities and roads, and using previously-disturbed areas (including existing transmission corridors, clearings and built roads) to the greatest extent possible.

16.4.5.2.4 Olive-sided Flycatcher

Olive-sided flycatcher is listed as Threatened on Schedule 1 of the SARA due to short-term and long-term population declines across their range (EC 2016b) and is blue-listed in BC (BC CDC 2017). Threats to olive-sided flycatcher are not well understood, but may include natural system modifications (e.g., reduced availability of insect prey and forest fire suppression), habitat loss and degradation, accidental mortality (e.g., collisions with vehicles, aircraft, and man-made structures), climate change and extreme weather events, pollution (e.g., pesticides, mercury, and acid precipitation), and problematic native and invasive non-native species that may prey on flycatchers or displace them from their nesting habitat (EC 2016b). Olive-sided flycatcher is identified as a priority species in BCR 5 (EC 2013). Critical habitat has not yet been defined for this species.

Olive-sided flycatcher are summer residents in northern BC; the first spring migrants arrive in early May. Olive-sided flycatcher will often forage for insects near or above the tree canopy where light intensity is at its maximum. Breeding occurs from late May through early August, and birds head back to their wintering grounds by the end of August. Nesting habitat for olive-sided flycatcher can be found in a wide variety of forest types and structural stages from young stands to old forest (Appendix 16-A).

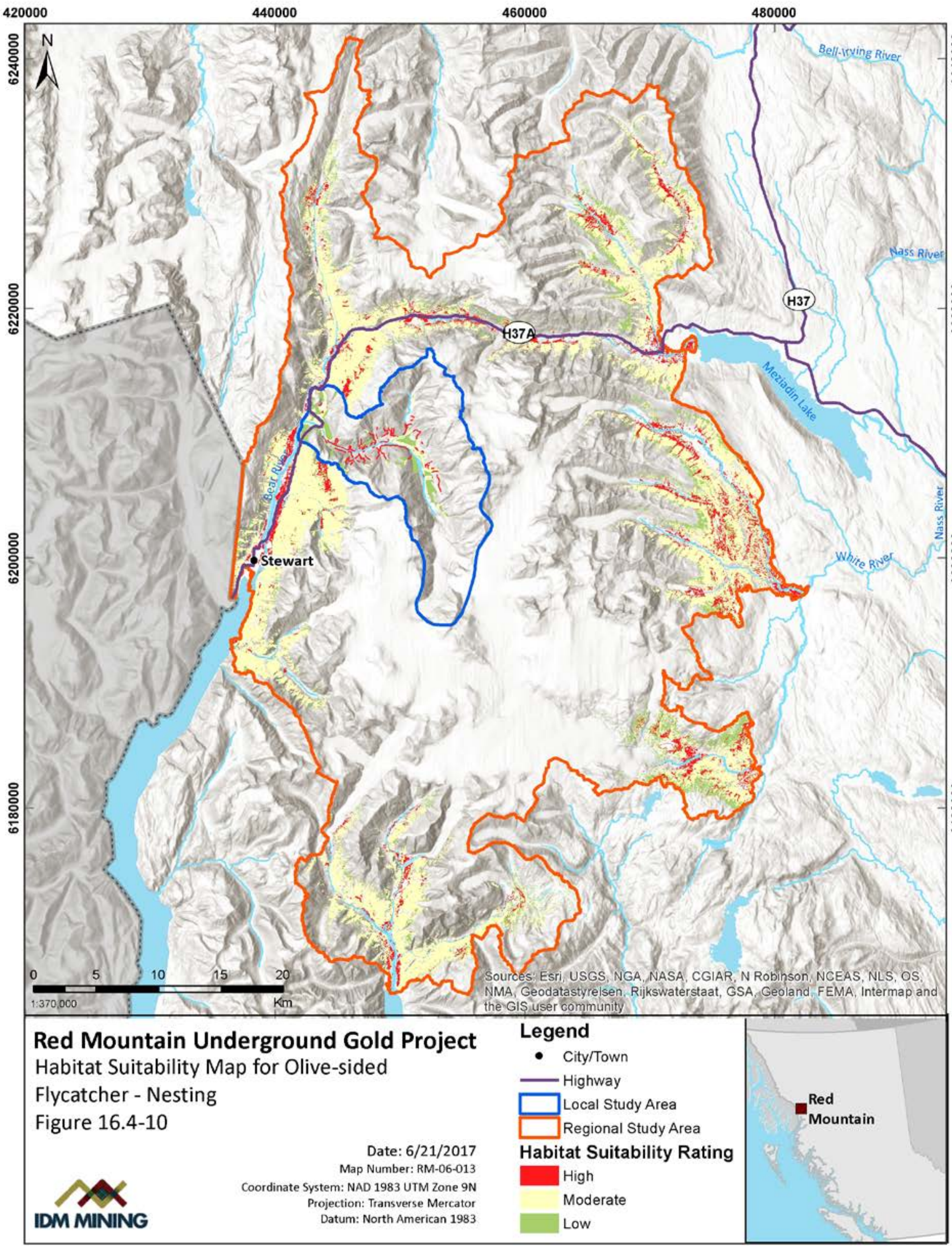
Habitat preference is for open coniferous or mixed-coniferous forests that are located near water or wetlands and with tall trees or snags used for sallies for prey (Appendix 16-A, EC 2016b). Most nests are found in intact forest, although both natural and man-made edge habitat provides the open area favoured by this species. Conifer species such as Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) are preferred nesting trees. There also appears to be a positive correlation between fire disturbance and occurrence of olive-sided flycatcher. Nest sites can be found from 400 to 3,400 masl, with the majority occurring between 1,000 and 2,000 masl (Appendix 16-A).

A habitat suitability model with a 4-class rating scheme was developed for olive-sided flycatcher within the LSA and RSA using the reproducing life requisite (Appendix 16-A). Attributes of suitable nesting habitat included open forest habitat with numerous tall trees (alive or dead) between structural stage 3-7 (Appendix 16-A; Figure 16.4-10).

Overall suitability of nesting habitat for olive-sided flycatcher within the LSA was relatively low (less than 1%) with small patches located in riparian habitats along Bitter Creek in the CWHwm and MHmm1 BGC subzones (Appendix 16-A). Several small patches of high or moderate suitability habitat were also identified near Clements Lake in the CWHwm BGC subzone (Appendix 16-A). Within the LSA 5% (809 ha) was identified as high or moderate habitat suitability for nesting olive-sided flycatcher. Within the RSA 16% (32,742 ha) was identified as high or moderate habitat suitability for nesting olive-sided flycatcher. Habitat suitability ratings identified by the model agreed with field ratings in 90% of cases (Appendix 16-A).

Olive-sided flycatcher was inventoried during the breeding bird surveys in the LSA between June 4 and July 10, 2016, using unlimited radius point count methods following provincial and federal standards (Appendix 16-A). Point count stations were stratified by BGC zone and structural stage in order to obtain representative samples from each habitat type across the LSA. A total of 61 point count stations were surveyed. Approximately 52% of these stations were located in suitable habitat for olive-sided flycatcher; however, no olive-sided flycatchers were detected during the breeding bird surveys or opportunistically during other field surveys. Both the Brucejack Mine (Rescan 2014) to the north of the RSA and the Avanti Kitsault Project (AMEC 2011) to the south of the RSA detected olive-sided flycatcher in similar habitats to those found within the LSA.

Figure 16.4-10: Habitat Suitability Map for Olive-sided Flycatcher — Nesting



16.4.5.3 Raptors

16.4.5.3.1 Northern Goshawk

The northern goshawk is a large forest raptor that breeds throughout the forested regions of Canada and portions of the United States and Mexico (Squires and Reynolds 1997). Two subspecies occur in BC: *A. g. atricapillus* and *A. g. laingi* (Campbell et al. 1990). The northern goshawk *atricapillus* subspecies breeds throughout the interior of BC (Campbell et al. 1990) and is not listed federally or provincially (BC CDC 2017). The northern goshawk *laingi* subspecies breeds on Vancouver Island, Haida Gwaii, other coastal islands, and the coastal mainland west of the Coast Mountains (NGRT 2008; FLNRO 2013). This subspecies is listed as Threatened on Schedule 1 of the SARA due to habitat loss and low population numbers (COSEWIC 2013b), is red-listed in BC (BC CDC 2017), and has been identified as a priority species in BCR 5 (EC 2013). For the purpose of this report, effects will be assessed for the *laingi* subspecies since the Bitter Creek valley is located well within the boundaries of this subspecies range.

The main threats to the northern goshawk *laingi* subspecies are forest harvesting and other commercial activities that remove forests on a large scale (NGRT 2008; FLNRO 2013; COSEWIC 2013b). These activities reduce and fragment nesting and foraging habitat, adversely affecting the availability of suitable nest sites and the abundance and diversity of prey. Habitat fragmentation also increases travel distances between suitable foraging areas, which in turn increases energetic costs for breeding adults. Furthermore, habitat fragmentation facilitates an increase in edge-dwelling species, which may prey on adults, nestlings, and eggs, or compete for suitable nesting sites. Other threats are considered minor for this subspecies.

The northern goshawk *laingi* subspecies is non-migratory. Males remain on or near their nesting territories year-round while females typically move to lower elevations during winter (COSEWIC 2013b). Pairs return to their nesting territories between early February and late March and courtship ensues until early April with egg-laying occurring in mid- to late April (Appendix 16-A). Eggs hatch between late May and mid-June and fledglings typically leave the nest by early to mid-July (McClaren 2004). Fledglings remain within close proximity to the nest site for 40 to 60 days before dispersing as independent adults between early August and early September (McClaren 2004).

Stand structure rather than stand age or species composition is typically the most important habitat attribute that drives nesting habitat selection for the northern goshawk *laingi* subspecies (McClaren et al. 2015). Suitable stand structure generally includes closed canopies, open understories, sub-canopy flyways, and suitable nest platforms (McClaren et al 2015). These attributes are most commonly found in mature and old growth forests, but may also be found in younger stands under the right conditions (e.g., high site productivity coupled with natural stand thinning or silviculture treatments; McClaren et al. 2015). Breeding sites can be found from sea level to 900 masl, although higher elevations may be avoided due to the increased energy expenditure required to access high elevations, especially if carrying food for offspring (Appendix 16-A).

The breeding territory of the northern goshawk consists of two key components. The *breeding area* is the key functional unit for all aspects of goshawk breeding ecology, including courtship, incubation, and post-fledging activities, as well as roosting and food deliveries. The extent of the breeding area is defined by the combined space of alternative nests and surrounding post-fledging areas (area used by juveniles between fledging and dispersal) within the same territory. The estimated size of breeding areas for the northern goshawk *laingi* subspecies in coastal BC ranges from 46 to 263 ha (McClaren et al. 2015). The *breeding home range* is the area surrounding the breeding area in which the adults pursue and capture prey, and ranges in size from 3,700 to 8,500 ha in coastal BC (McClaren 2015).

A habitat suitability model with a 4-class rating scheme was developed for northern goshawk within the LSA using the reproducing life requisite (Appendix 16-A for modeling methodologies). The habitat suitability ratings closely followed the nesting habitat suitability model developed by Mahon et al. (2015) for the Coastal Northern Goshawk Recovery Team (Appendix 16-A). Habitat suitability ratings identified by the model for the LSA agreed with field ratings in 90% of cases (Appendix 16-A). High or moderate suitability nesting habitat for northern goshawk within the LSA was 743 ha (approximately 5%) and was limited to the lower slopes near the floodplains of the Bitter Creek valley and to some extent around Clements Lake.

For the RSA, the provincial habitat model for northern goshawk *laingi* subspecies (Mahon et al. 2015) was used to identify habitat suitability. In the RSA, 6,692 ha (approximately 3%) of high or moderate suitability nesting habitat occurred and was distributed in valley bottom to mid slope positions across most major valleys in the RSA.

Northern goshawk inventories were conducted in the LSA during the breeding season using call-playback inventory methods following provincial standards (Appendix 16-A). Initial surveys were conducted from August 10 to 16, 2015, to locate suitable breeding habitat. When suitable nesting habitat was located, opportunistic call-playback surveys were conducted using juvenile begging calls. Two rounds of systematic call-playback surveys were then conducted in 2016 throughout the suitable nesting habitat identified during the 2015 field surveys. Adult male alarm calls were used during the June 5 to 10 call-playback survey and juvenile begging calls were used during the July 4 to 10 call-playback survey. A total of 17 call-playback stations were surveyed during the 2016 field surveys (Appendix 16-A). One northern goshawk responded to call-playback at one station in 2016 in the lower Bitter Creek valley (see Appendix 16-A Figure 4-46). One juvenile goshawk was also detected in the lower Bitter Creek valley during summer field surveys in 2014. Both observations occurred in areas identified as high habitat suitability. No other goshawks were detected (Appendix 16-A). No nest sites were located in association with either detection.

16.4.5.3.2 Western Screech-owl

The western screech-owl *kennicottii* subspecies is listed as Special Concern on Schedule 1 of the SARA due to population declines in the southern part of its range (COSEWIC 2012b), and is blue-listed in BC (BC CDC 2017). This subspecies is identified as a priority species in BCR 5 (EC 2013). The western screech-owl *kennicottii* subspecies is also likely declining in the northern part of its range based on observations reported in Alaska; however, the magnitude of this decline is unknown (COSEWIC 2012b). The main threats to the *kennicottii* subspecies are believed to be predation from recently established barred owl (*Strix varia*) populations (particularly on the south coast) and habitat loss and fragmentation via forest harvesting and urban expansion (COSEWIC 2012b). The removal of dead trees and snags can be particularly detrimental as these habitat components provide important roosting and nest cavity sites. An additional threat identified in the COSEWIC (2012b) status report is the potential effects of highway-speed vehicle collisions on the *macfarlani* subspecies of western screech-owl in the Okanagan area of south-central BC.

Western screech-owls are non-migratory with pairs defending territories year-round (COSEWIC 2012b). Courtship begins in February with egg-laying occurring between mid-March and late May (Campbell et al. 1990). Eggs hatch beginning in mid-April and fledglings typically leave the nest by early to mid-June (Campbell et al. 1990). Fledglings remain within close proximity to the nest site for two to four days before venturing further away with the adults (Campbell et al. 1990). Fledglings remain with the adults for approximately five weeks before they disperse as independent adults in July or August (Campbell et al. 1990).

Western Screech-owls are secondary cavity nesters and prefer to nest in large deciduous trees, although coniferous trees may also be used (Appendix 16-A). Nest trees are typically located in mixed forests along streambanks; however, nest trees may also be located near bodies of standing water including marshes, bogs, and lakes. Nest sites are typically found at low elevations below 600 masl (Appendix 16-A).

A habitat suitability model with a 4-class rating scheme was developed for western screech-owl within the LSA and RSA using the food/cover and reproducing life requisites described in the wildlife baseline report (Appendix 16-A). Attributes of suitable habitat included mature or old-growth riparian forest near streams (i.e., structural stage 6–7), and suitability ratings identified by the model agreed with field ratings in 98% of the cases. Suitable nesting habitat for western screech-owl was limited to a few very small patches of old structural stage western hemlock near the confluence of Bitter Creek with the Bear River (Appendix 16-A). Habitat identified by the model as high or moderate was less than 1% of the LSA (71 ha) and 2% of the RSA (4,127 ha), and there have been no observations during baseline studies; therefore, it is unlikely that Western Screech-owl is present within the LSA. If western screech-owls were to occur within the LSA, they likely occur in very low numbers and most likely are restricted to the lower floodplain where Bitter Creek flows into the Bear River.

Field surveys from August 10 to 16, 2015, focused on habitat assessments for western screech-owls (Appendix 16-A). Call-playback surveys were not conducted since the field visit was conducted outside of the recommended breeding season (i.e., February to June) (Appendix 16-A). A small amount of low suitability nesting habitat was located during the 2015 habitat assessments, but no evidence of western screech-owl nesting was observed. Call-playback surveys were not conducted for western screech-owl during the 2016 field surveys partly because concerns were raised that call-playback surveys may draw predatory responses from barred owls. Therefore, a combination of habitat assessments and silent listening at the common nighthawk survey locations were used to assess western screech-owl presence within the LSA in 2016. There were no detections of western screech-owl.

16.4.5.4 Non-migratory Game Birds

16.4.5.4.1 Sooty Grouse

The sooty grouse is not listed federally or provincially in BC. It has been identified as a priority species in BCR 5 (EC 2013) and is a candidate wildlife species for assessment by COSEWIC. While previously considered to be coastal subspecies of blue grouse (*Dendragapus obscurus*), recent deoxyribonucleic acid (DNA) research indicates sooty grouse is a separate species (Starzomski 2015 in Davidson et al. 2015). Sooty grouse populations have declined more than 50% since 1970 (EC 2014b). The main threats to birds in BCR 5 include habitat loss and degradation due to forest harvesting and commercial/residential development, climate change and extreme weather events, pollution (e.g., oil spills), and problematic invasive non-native species that may prey on birds or displace them from their nesting habitat (EC 2013).

The sooty grouse is one of the largest grouse species in North America and occurs along the western edge of Canada and the United States from sea level to mountainous regions year-round (Zwickel and Bendell 2004). The birds are non-migratory and inhabit brushy open areas within mature or second-growth coniferous forests. During summer the grouse can also be found in open subalpine and alpine areas where there is little tree cover (Campbell et al. 1990; Zwickel and Bendell 2005). Beginning in late summer and continuing through to November, birds in alpine areas and lowland forests begin move to overwintering habitat at mid-elevations.

Sooty grouse move to breeding territories (e.g., lowlands or subalpine areas) in late winter and begin courtship. Nests are located on the ground with some form of cover (e.g., grasses, shrubs, logs, small trees) above for concealment. Eggs are typically laid between April and June and hatch roughly one month after laying. Young leave the nest within the first day and two-week old chicks are capable of sustained flight. By late September, juveniles disperse and become independent (Campbell et al. 1990; Zwickel and Bendell 2005).

A habitat suitability model with a 4-class rating scheme was developed for the Project using the living and reproducing life requisites described in the Wildlife Baseline Report (Appendix 16-A; Figure 16.4-11 and Figure 16.4-12). Suitability ratings identified by the models agreed with field ratings in 93 to 98% of the cases.

Sooty grouse was detected during the general breeding bird surveys conducted within the LSA (June 4 and July 10, 2016) using unlimited radius point count methods following provincial and federal standards. Sooty grouse were recorded five times during songbird point counts within mid to high elevations, except for one detection adjacent to Clements Lake. During other field surveys, one female sooty grouse was found incubating eggs in upper elevation near the confluence of Goldslide Creek and the Bromley Glacier.

Based on records of licensed harvest in the RSA (MU 6-14 and MU 6-16; data provided by FLNRO; K. Dixon pers. comm. 2017) between 1976 and 2015, a total of 559 sooty grouse (blue grouse) were harvested with an average of 14 sooty-grouse/year (range 0 to 153 sooty grouse/year). The LSA is found within MU 6-14, where between 1976 and 2015, a total of 372 sooty grouse were harvested.

Figure 16.4-11: Habitat Suitability Map for Sooty Grouse — Nesting

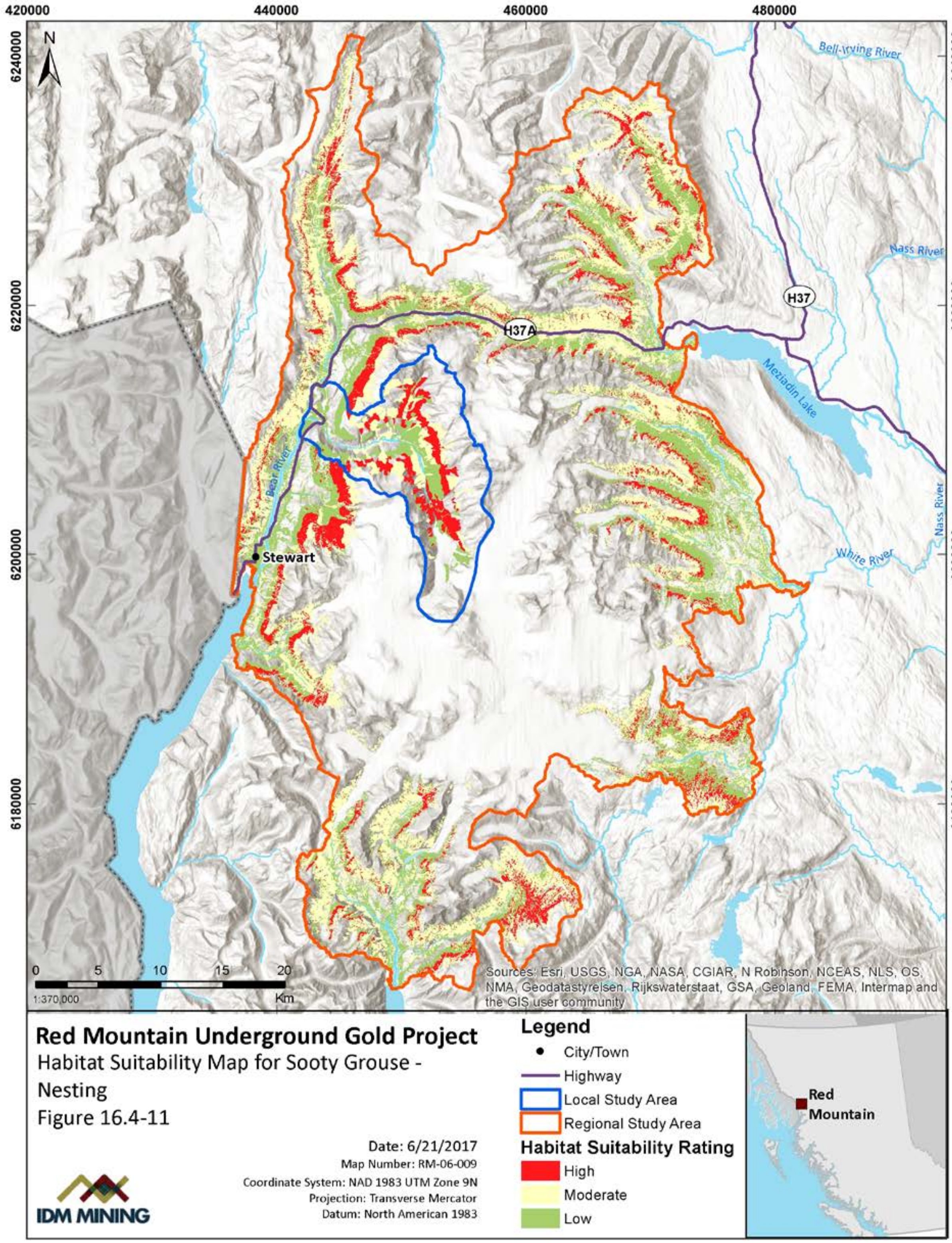
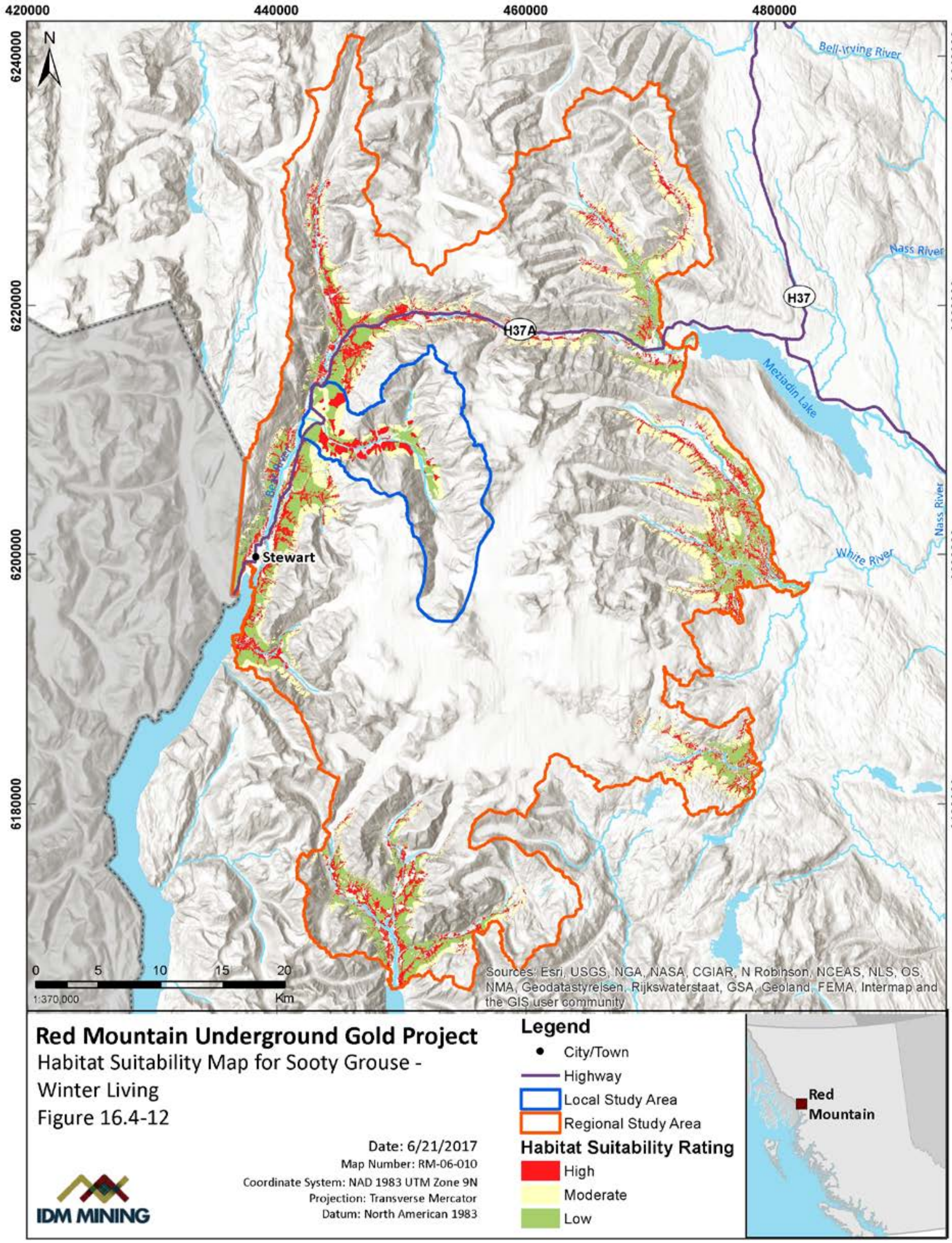


Figure 16.4-12: Habitat Suitability Map for Sooty Grouse — Winter Living



16.4.5.4.2 White-tailed Ptarmigan

The white-tailed ptarmigan is not listed federally or provincially in BC. It has been identified as a priority species in BCR 5 (EC 2013). The main threats to birds in alpine and subalpine habitats include habitat loss and degradation due to climate change and resource extraction activities (e.g., mining and oil and gas exploration and development) (ECCC 2016c). Climate change may adversely affect alpine and subalpine habitats. Industrial development, including mining, may alter habitat increase collisions with vehicles. Increased levels of human activities in alpine and subalpine habitats may also have adverse effects.

The white-tailed ptarmigan is the smallest grouse species in North America and occurs in alpine or upper subalpine habitats year round (Martin et al. 2015). It is a common year-round resident at high elevation alpine areas throughout the mainland of BC, from the Coast and Cascade Mountains east to the Rocky Mountains. It is uncommon at high elevations on Vancouver Island, and is absent from all other coastal islands (including Haida Gwaii). It occurs almost exclusively in rocky alpine tundra, alpine rockslides, talus, krummholz vegetation, and at the edges of glaciers and snowfields (Campbell et al. 1990).

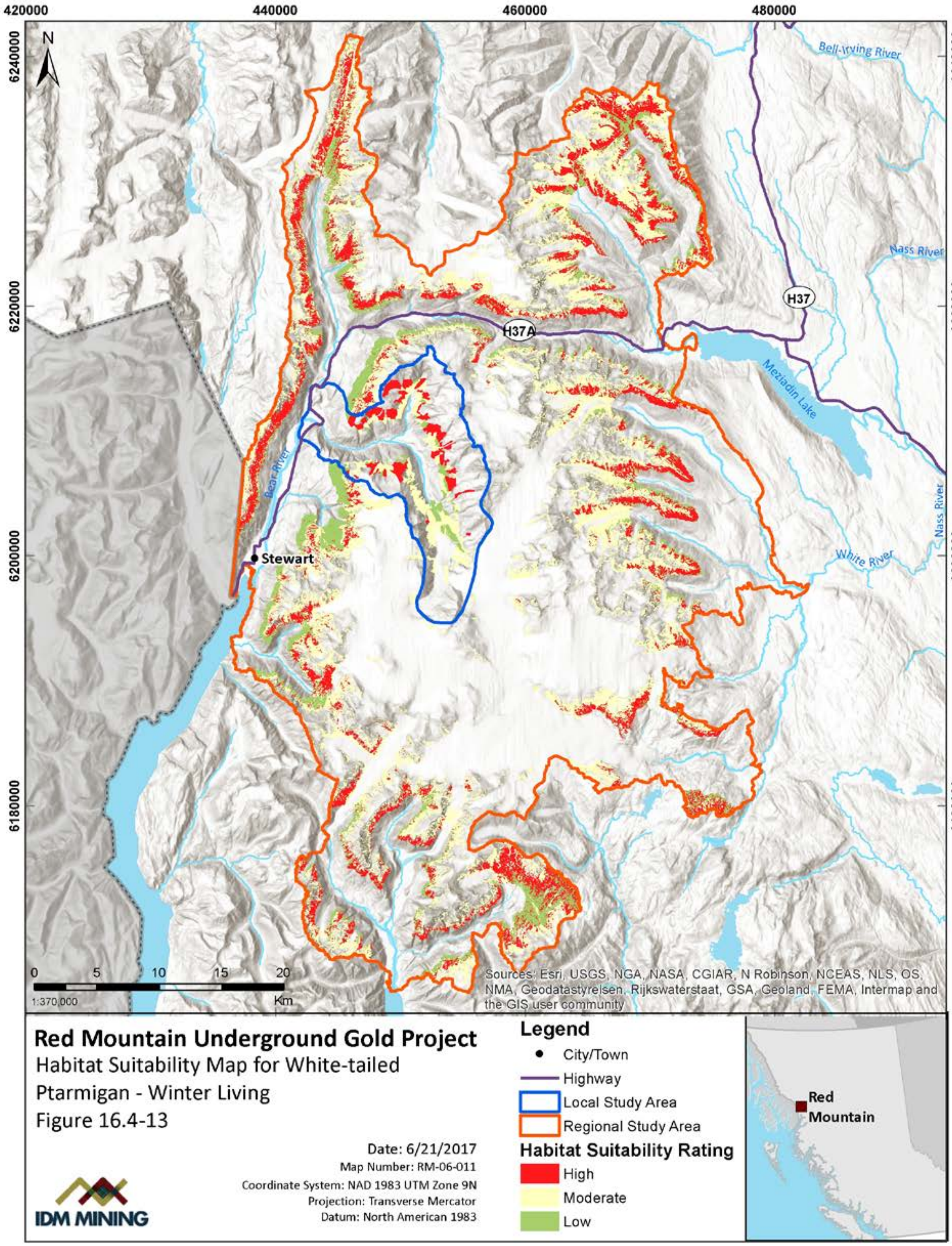
White-tailed ptarmigan nests in alpine tundra, in rocky areas or sparsely vegetated, grassy slopes as well as in areas of willow shrubs with subshrub, moss, and boulder cover. Birds tend to search for vacant territory in their natal area and exhibit a high fidelity to breeding territory in successive years (Frederick and Gutierrez 1992). Eggs are laid between mid-May and early July and hatch roughly one month later. Young leave the nest within the first day and are able to fly at 10 days. Juveniles remain with the family group through the first winter and disperse in the following spring (Campbell et al. 1990; Braun et al. 1993; Baicich and Harrison 1997; Madge and McGowan 2002 in Fenneman 2014).

A habitat suitability model with a 4-class rating scheme was developed using the life requisites described in the Baseline Wildlife Resources Report (Appendix 16-A; Figure 16.4-13). Since habitat requirements for nesting and winter living are similar, only one model (winter living) was developed for this species. Attributes of suitable habitat included alpine tundra, rocky or sparsely vegetated areas, brushy willow, or krummholz vegetation. Suitable habitat incorporated areas providing suitable forage (willow, birch, alder) often near the treeline. Suitability ratings identified by the model agreed with field ratings in 93% of the cases.

Suitable winter living habitat identified by the model was distributed in the lower elevations of the LSA within mature forest ecosystems: frequently along Bitter Creek and near Clements Lake. Habitat identified by the model as high or moderate was approximately 18% of the LSA (2,868 ha) and 23% of the RSA (46,268 ha).

White-tailed ptarmigan were frequently observed during field surveys and on wildlife cameras in 2015 and 2016, though no specific-specific surveys were conducted. All observations were recorded within alpine habitat. Breeding evidence was observed in 2015 with the detection of one female with two chicks close to the existing exploration camp in the Goldslide Creek drainage.

Figure 16.4-13: Habitat Suitability Map for White-tailed Ptarmigan — Winter Living



16.4.6 Amphibian Characterization

16.4.6.1 Western Toad

The western toad is listed as a species of Special Concern by COSEWIC and under Schedule 1 of the SARA. It is also blue-listed within the province of BC (BC CDC 2017). Population declines in southern BC and elsewhere in its home range (e.g., United States) have prompted conservational concern (BC CDC 2017). Threats to western toad populations include habitat loss and fragmentation, road mortality from transportation and service corridors, invasive and problematic species, infection with the amphibian chytrid fungus *Batrachochytrium dendrobatidis*, logging, pollution, and climate change (ECCC 2016d). The greatest threat related to mining is likely associated with habitat fragmentation and mortality due to development and use of new roads (PWTWG 2014; ECCC 2016d).

Western toad use breeding, terrestrial summer range, and winter hibernacula habitats. Western toad preferred breeding sites include wetted areas of permanent or temporary waterbodies with shallow sandy bottoms; however, breeding can occur in a wide variety of aquatic habitats. Breeding activity typically occurs between April and July and can extend into August in the coastal mountains. Western toads may vocalize during breeding depending on the population; within the Bitter Creek valley, the western toad population is non-calling (COSEWIC 2012c). Eggs are laid in gelatinous double-strings either directly on the bottom substrate or entwined in aquatic vegetation. Larvae hatch within 7 to 10 days into black tadpoles that aggregate in shallow areas, typically near the shoreline. Within 2 to 3 months of egg deposition, larvae metamorphose into toadlets and remain within the riparian area for a short time until they emigrate *en masse* from the breeding site to seek terrestrial overwintering sites (BC CDC 2017). The toads disperse into forests and grasslands after breeding and travel relatively large distances from their breeding ponds (e.g., 0.94 km for males and 2.44 km for females (Muths 2003, Bartelt et al. 2004). In the winter (November to April) they hibernate in underground dens or burrows that are below the frost line (COSEWIC 2012c).

Following breeding, adults may forage in the riparian edges of breeding sites, or disperse up to several kilometres to forage in other wetlands, riparian areas or upland sites. Females tend to travel farther than males to reach foraging grounds, with males more closely associated with water. They seek overhead cover, including dense shrubs, coarse woody debris, and boulders or mammal burrows, presumably for protection from dessication and predation. Adults spend up to 90% of their time in terrestrial habitats. Western toads are vulnerable to disturbance at breeding sites and during migrations to and from breeding sites.

Breeding or reproducing habitat is the most limiting component for year-round western toads. A habitat suitability model with a 4-class rating scheme was developed for western toads within the LSA using the breeding life requisite described in the Wildlife Baseline Report (Appendix 16-A). Attributes of suitable breeding habitat focused on herb-dominated shallow water wetlands (i.e., structural stage 2 or 3). High and moderate suitability ratings identified by the model agreed with field ratings in 100% of the cases.

The model identified limited breeding habitat for western toad within the LSA. A total of 94 ha (less than 1%) of high or moderate suitability breeding habitat was identified within the LSA. High suitability breeding habitat was limited to Clements Lake and a small wetland in the northwest corner of the LSA near Highway 37A. Moderate suitability was distributed in narrow riparian areas and floodplains in the mid to upper reaches of Bitter Creek watershed.

A total of 24 hours of time-constrained searching was conducted in the LSA in suitable breeding habitat for western toad. Two western toadlets were observed during the August 2015 surveys at Clements Lake. Western toads were not observed in 2016 even though searches covered the full range of breeding season from early June to the end of August.

16.5 Potential Effects

16.5.1 Methods

Potential interactions between Project components or activities and Wildlife VCs, and the corresponding potential effects of these interactions, were identified based on the following questions:

- Based on the information available, is the Project component or activity expected to interact with Wildlife VCs?
- What are the types of effects that result from the interaction of the Project's components or activities with Wildlife VCs over different Project phases? Is the interaction expected to lead to potential effects on Wildlife VCs to a degree that would require mitigation?
- Which interactions have the greatest potential to cause adverse residual effects or are of particular concern to the public, Aboriginal Groups, government agencies, or stakeholders?

Addressing these questions allowed the assessment to be focused on Project-wildlife interactions that were of highest likelihood of occurring and with the greatest risk.

16.5.2 Project Interactions

The Project interaction matrix presented in Table 16.5-1 provides a summary of potential interactions between Project components or activities and Wildlife VCs and the corresponding potential effects of these interactions. The pathway components identified to inform the assessment of potential effects to Wildlife were used to develop this interaction matrix. For example, the assessment data for the ICs Terrain Stability and Geohazards and Hydrology were used to inform whether an interaction will occur between wildlife habitat and underground Mine Site activities.

Table 16.5-1: Project Interaction Matrix for Wildlife

Project Component / Activity	Mountain goat	Grizzly bear	Moose	Furbearers	Hoary marmot	Bats	Migratory Breeding Birds	Migratory Bird Species at Risk	Raptors	Non-Migratory Game Birds	Western toad	Potential Effect / Pathway of Interaction
Construction Phase												
Workforce (including employment of staff and contractors)	X	X	X	X	-	-	-	-	-	X	-	Potential increased hunting pressure due to increased access and increased presence in the Bitter Creek valley.
Construct Access Road and Haul Road from Hwy 37A to the Upper Portal	X	X	X	X	X	X	X	X	X	X	X	Habitat alteration; sensory disturbance; disruption to movement[1]; direct mortality; indirect mortality[2]; attractants
Install Powerline from substation tie-in to the Lower Portal laydown area	X	X	X	X	X	X	X	X	X	X	X	Habitat alteration; sensory disturbance; disruption to movement[1]; direct mortality; indirect mortality[2]; attractants
Excavate and secure Lower Portal entrance and access tunnel	X	X	X	-	X	-	X	-	X	X	-	Habitat alteration; sensory disturbance
Construct Mine Site water management infrastructure including talus quarries and the portal collection pond, dewatering systems, and water diversion, collection and discharge ditches and swales.	X	X	-	X	X	-	-	-	-	X	-	Habitat alteration; sensory disturbance; direct mortality; indirect mortality; attractants

Project Component / Activity	Mountain goat	Grizzly bear	Moose	Furbearers	Hoary marmot	Bats	Migratory Breeding Birds	Migratory Bird Species at Risk	Raptors	Non-Migratory Game Birds	Western toad	Potential Effect / Pathway of Interaction
Install and fill Fuel Tanks at Mine Site	X	X	X	X	X	X	X	X	X	X	X	Habitat alteration; sensory disturbance; direct mortality; chemical hazards; attractants
Construct Explosives Magazine	X	X	-	X	-	-	-	-	-	X	-	Habitat alteration; sensory disturbance; direct mortality; chemical hazards
Construct other Mine Site ancillary buildings and facilities	X	X	-	X	X	-	-	-	-	X	X	Habitat alteration; sensory disturbance; direct mortality; indirect mortality; attractants
Discharge of water from underground workings at the Mine Site	-	-	-	-	-	-	-	-	-	-	X	Potential for effects to wetland or open water habitat depending on location of discharge
Initiate underground lateral development and cave gallery excavation	-	-	-	-	-	X	-	-	-	-	-	Habitat alteration; sensory disturbance
Temporarily stockpile ore at the Mine Site	X	X	-	-	X	-	-	-	-	X	-	Habitat alteration; sensory disturbance; direct mortality
Transport and deposit waste rock to the Waste Rock Storage Area	X	X	-	-	X	-	-	-	-	X	-	Sensory disturbance

Project Component / Activity	Mountain goat	Grizzly bear	Moose	Furbearers	Hoary marmot	Bats	Migratory Breeding Birds	Migratory Bird Species at Risk	Raptors	Non-Migratory Game Birds	Western toad	Potential Effect / Pathway of Interaction
Water withdrawal for the purposes of dust suppression and construction use (primarily contact water management ponds; secondarily Bitter Creek, Goldslide Creek, and Otter Creek) and to meet freshwater needs (Otter Creek, Goldslide Creek)	-	X	X	-	-	-	X	-	-	-	X	Sensory disturbance
Clear and prepare the TMF basin and Process Plant site pad	X	X	X	X	-	X	X	X	X	X	X	Habitat alteration; sensory disturbance; direct mortality
Excavate rock and till from the TMF basin and local borrows / quarries for construction activities (e.g., dam construction for the TMF)	X	X	X	X	-	X	X	X	X	X	-	Sensory disturbance
Establish water management facilities including diversion ditches for the TMF and Process Plant	X	X	X	X	-	X	X	X	X	X	X	Habitat alteration; sensory disturbance; direct mortality; attractants
Construct the TMF	X	X	X	X	-	-	X	X	X	X	-	Sensory disturbance
Construct the Process Plant and Run of Mine Stockpile location	X	X	X	X	X	X	X	X	X	X	X	Habitat alteration; sensory disturbance; direct mortality

Project Component / Activity	Mountain goat	Grizzly bear	Moose	Furbearers	Hoary marmot	Bats	Migratory Breeding Birds	Migratory Bird Species at Risk	Raptors	Non-Migratory Game Birds	Western toad	Potential Effect / Pathway of Interaction
Construct water treatment facilities and test facilities at Bromley Humps	X	X	X	X	X	X	X	X	X	X	X	Habitat alteration; sensory disturbance; direct mortality
Construct Bromley Humps ancillary buildings and facilities	X	X	X	X	X	X	X	X	X	X	X	Habitat alteration; sensory disturbance; direct mortality; indirect mortality[2]; attractants
Commence milling to ramp up to full production	X	X	X	X	-	X	X	X	X	X	-	Sensory disturbance
Operation Phase												
Workforce (including employment of staff and contractors)	X	X	X	X	-	-	-	-	-	X	-	Potential increased hunting pressure due to increased access and increased presence in the Bitter Creek valley, sensory disturbance
Use Access Road for personnel transport, haulage, and delivery of goods	X	X	X	X	X	X	X	X	X	X	X	Sensory disturbance; disruption to movement[1]; direct mortality
Maintain Access Road and Haul Road, including grading and plowing as necessary	X	X	X	X	-	-	-	-	-	X	X	Sensory disturbance; disruption to movement[1]; direct mortality; indirect mortality; attractants
Maintain Powerline right of way from substation tie-in to portal entrance, including brushing activities as necessary	X	X	X	X	X	-	X	X	X	X	X	Sensory disturbance; disruption to movement[1]; direct mortality; indirect mortality; attractants

Project Component / Activity	Mountain goat	Grizzly bear	Moose	Furbearers	Hoary marmot	Bats	Migratory Breeding Birds	Migratory Bird Species at Risk	Raptors	Non-Migratory Game Birds	Western toad	Potential Effect / Pathway of Interaction
Continue underground lateral development, including dewatering	-	-	-	-	-	X	X	-	-	-	-	Direct mortality; vegetation changes due to changes in hydrology
Discharge of water from underground facilities	-	-	-	-	-	-	-	-	-	-	X	Potential for effects to wetland or open water habitat, depending on location of discharge
Haul waste rock from the declines to the Waste Rock Storage Area for disposal (waste rock transport and storage)	X	X	X	X	X	-	X	X	X	X	X	Sensory disturbance; direct mortality; disruption to movement [1]
Extract ore from the underground load-haul-dump and transport to Bromley Humps to Run of Mine Stockpile (ore transport and storage)	X	X	X	X	X	-	X	X	X	X	X	Sensory disturbance; direct mortality; disruption to movement [1]
Excess process water for the Process Plant will be obtained through water withdrawal from contact water management ponds, treated effluent water, and/or Otter Creek	-	-	-	-	-	-	X	-	-	-	X	Vegetation changes due to changes in hydrology

Project Component / Activity	Mountain goat	Grizzly bear	Moose	Furbearers	Hoary marmot	Bats	Migratory Breeding Birds	Migratory Bird Species at Risk	Raptors	Non-Migratory Game Birds	Western toad	Potential Effect / Pathway of Interaction
Water withdrawal for the purposes of dust suppression along Project roads and to meet freshwater needs (Otter Creek, Goldslide Creek)	-	-	-	-	-	-	X	-	-	-	X	Vegetation changes due to changes in hydrology
Treat and discharge, as necessary, excess water from the TMF	X	X	X	X	X	X	X	X	X	X	X	Vegetation changes due to changes in hydrology; chemical hazards
Temporarily store hazardous substances including fuel, explosives, and mine supplies	X	X	X	X	X	X	X	X	X	X	X	Chemical hazards; attractants; potential for spills
Progressively reclaim disturbed areas no longer required for the Project	X	X	X	X	-	-	X	X	X	X	-	Sensory disturbance
Closure and Reclamation Phase												
Workforce (including employment of staff and contractors)	X	X	X	X	-	-	-	-	-	X	-	Potential increased hunting pressure due to increased access and increased presence in the Bitter Creek valley; sensory disturbance

Project Component / Activity	Mountain goat	Grizzly bear	Moose	Furbearers	Hoary marmot	Bats	Migratory Breeding Birds	Migratory Bird Species at Risk	Raptors	Non-Migratory Game Birds	Western toad	Potential Effect / Pathway of Interaction
Use and maintain Access Road for personnel transport, haulage, and removal of decommissioned components until road is decommissioned and reclaimed.	X	X	X	X	X	-	X	X	X	X	X	Sensory disturbance; disruption to movement[1]; direct mortality
Decommission underground infrastructure	X	X	X	X	-	X	X	X	X	X	-	Sensory disturbance; direct mortality (bats)
Flood underground	-	-	-	-	-	-	X	-	-	-	X	Vegetation change due to changes in hydrology
Install bulkhead(s) in the declines and ventilation exhaust raise	-	-	-	-	-	X	-	-	-	-	-	Direct mortality
Decommission and reclaim Lower Portal area and powerline	X	X	X	X	-	-	X	X	X	X	-	Sensory disturbance
Decommission and reclaim Haul Road	X	X	X	X	-	-	X	X	X	X	-	Sensory disturbance
Decommission and reclaim all remaining mine infrastructure (Mine Site and Bromley Humps, except TMF) in accordance with the Closure and Reclamation Chapter (Volume 2, Chapter 5)	X	X	X	X	-	-	X	X	X	X	-	Sensory disturbance

Project Component / Activity	Mountain goat	Grizzly bear	Moose	Furbearers	Hoary marmot	Bats	Migratory Breeding Birds	Migratory Bird Species at Risk	Raptors	Non-Migratory Game Birds	Western toad	Potential Effect / Pathway of Interaction
Construct the closure spillway	X	X	X	X	-	-	X	X	X	X	-	Sensory disturbance
Treat and discharge water from the TMF	X	X	X	X	X	X	X	X	X	X	X	Vegetation changes due to changes in hydrology; chemical hazards
Conduct maintenance of mine drainage, seepage, and discharge	X	X	X	X	X	X	X	X	X	X	X	Chemical hazards
Remove discharge water line and water treatment plant	X	X	X	X	-	-	X	X	X	X	-	Sensory disturbance
Decommission and reclaim Access Road	X	X	X	X	-	-	X	X	X	X	-	Sensory disturbance
Post-Closure Phase												
Flood underground	-	-	-	-	-	-	X	-	-	-	X	Vegetation change due to changes in hydrology
Post-Closure monitoring	X	X	X	X	-	-	-	-	-	X	-	Potential increased hunting pressure due to increased access and increased presence in the Bitter Creek valley; sensory disturbance

[1] Disruption to movement does not apply to bird and bat VCs
[2] Indirect mortality does not apply to bat VC

16.5.3 Discussion of Potential Effects

The potential effects for wildlife VCs (Table 16.5-1) include:

- Habitat alteration;
- Sensory disturbance;
- Disruption to movement;
- Direct mortality;
- Indirect mortality;
- Chemical hazards; and
- Attractants

16.5.3.1 Habitat Alteration

Habitat alteration includes the loss or alteration of wildlife habitat due to the Project footprint that results in the displacement of wildlife for a period of time. This is a potential effect during the Construction Phase of the Project when the Project footprint is cleared of vegetation, and will persist throughout the Operation and Closure and Reclamation Phases until Project components are removed and reclaimed. Habitat alteration is considered a potential effect for all Wildlife VCs. The Project Overview (Chapter 1) provides a description of off-site and on-site Project components such as the Access Road, Powerline, Process Plant, TMF, Mine Site, and ancillary infrastructure that were considered during assessment of habitat alteration.

16.5.3.2 Sensory Disturbance

Sensory disturbance includes the potential for Project-related noise, light, dust, or human presence to elicit behavioural changes in wildlife. The behavioural responses may result in a potential effect during all Project phases and for all Wildlife VCs. Project activities that will contribute to sensory disturbance during the Construction Phase include activities associated with vegetation clearing and ground disturbance, blasting, and construction of the Access Road, Powerline, and other Project components at Bromley Humps and the Mine Site. Project activities that will contribute to sensory disturbance during the Operation Phase include road use and maintenance, Powerline maintenance, mineral processing, and waste rock and ore transport or storage. Project activities that will contribute to sensory disturbance during the Closure and Reclamation Phase include the removal of surface structures and concrete foundations, backfilling, and the deactivation of road and Powerline rights of way. Project activities that will contribute to sensory disturbance during the Post-Closure Phase include the removal of the discharge water line and water treatment plant. Sensory disturbance will be greatest during the Construction Phase and Closure and Reclamation Phase when above ground works are more common. Sensory disturbance will be comparatively lower during the Operation Phase and is anticipated to lessen substantially during the Post-Closure Phase when minimal human activity will occur on site for monitoring and maintenance activities. Once production is completed, all Project components will be removed and reclaimed and the potential effects of sensory disturbance should cease.

Sensory disturbance is considered a potential effect for all VCs except western toads and hoary marmots.

Effects of sensory disturbance were determined to have no interaction with hoary marmot. Hoary marmots frequently habituate to human disturbance. There is evidence to suggest behavioural shifts from foraging to increased vigilance can occur as a result of human presence (Li et al. 2011). However, comparable survival rates, reproduction rates, or body conditions between marmots exposed to human presence and those unexposed indicate these behavioural shifts are not anticipated to have a population effect (Griffin et al. 2009).

Sensory disturbance is not considered a potential effect as the western toads in northwest BC are part of the non-calling subpopulation (COSEWIC 2012c) and are not sensitive to increased noise levels.

16.5.3.3 Disruption to Movement

Disruption to movement includes the potential effects of Project activities and infrastructure on habitat connectivity and wildlife movements. Project activities and infrastructure may create physical or sensory barriers or filters to movement between daily or seasonal habitats, which could have implications for the long-term persistence and viability of wildlife populations. When areas or corridors of vegetation are cleared, there is potential for disrupting wildlife movements. Linear features on the landscape (e.g., roads, power line corridors, and seismic lines) are common sources of this potential effect. Disruption to movement can also occur when infrastructure blocks wildlife movement through restricted terrain features (e.g., a narrow valley or canyon) or restricts wildlife movement within or between water bodies. Increased traffic levels on roads can confound the issue, adding a sensory barrier or filter to an already existing physical barrier or filter.

Project components that may contribute to disruption to movement from the Construction Phase through to the Closure and Reclamation Phase include the Access Road, Powerline, and TMF. The treatment and discharge of water from the TMF may contribute to disruption to movement from the Operation Phase through to the Post-Closure Phase. Once production is completed, all Project components will be removed and reclaimed and the potential effects of disruption to movement should cease.

Disruption to movement may occur during all Project phases and is considered a potential effect for all Wildlife VCs except bats and birds. Disruption to movement was considered as a physical barrier or disruption to movement versus habitat edge effects that are included in the habitat alteration and sensory disturbance assessment. Therefore disruption to movement was not anticipated to be a potential effect for birds and bats in this effects assessment. Bird and bat movements are not anticipated to experience a measureable adverse effect of disruption to movement as a result of the Project activities or infrastructure.

16.5.3.4 Direct Mortality

Direct mortality includes the potential direct effects of Project activities and infrastructure on wildlife mortality caused by vegetation clearing and ground disturbance during construction, collisions with Project-related traffic on the Mine Site and Access Road, or collisions and electrocution caused by the Powerline. Direct mortality also includes potential effects of entrapment in Project facilities, such as holding ponds or along the Access Road corridor during winter due to high snowbanks.

Direct mortality risk will be greatest during the Construction Phase when the Project footprint is cleared of vegetation and from the Construction Phase through the Operation Phase when vehicle traffic is anticipated to be highest. The risk is anticipated to lessen during the Closure and Reclamation Phase and will be negligible during the Post-Closure Phase when minimal human activity will occur on site for monitoring and maintenance activities. Once production is completed, all Project components will be removed and reclaimed and the potential effects of direct mortality should cease.

Direct mortality risk due to vegetation clearing and ground disturbance is more closely related to small mammals, roosting bats, nesting birds, and amphibians that may not be able to escape clearing equipment. Direct mortality risk due to wildlife-vehicle collisions or entrapment is related to all Wildlife VCs, while direct mortality risk due to the Powerline is related to bats and birds only.

16.5.3.5 Indirect Mortality

Indirect mortality includes the potential indirect effects of Project activities and infrastructure on wildlife mortality caused by increased hunting pressure due to improved access and new travel corridors that may facilitate predator access. This potential effect may occur from the Construction Phase through to the Closure and Reclamation Phase. The risk is anticipated to decrease during and beyond the Post-Closure Phase when roads will be closed. After Post-Closure, all Project components will be removed and reclaimed and the potential effects of indirect mortality should cease. Indirect mortality risk due to increased hunting pressure is related to large mammals, furbearers, and non-migratory game birds. There was not a Project interaction with bats related to indirect mortality because the Project activities and infrastructure do not create an opportunity for a measureable increase of predation pressure on bats.

Indirect mortality risk due to facilitated predation was considered but was not determined to be an interaction as a result of the Project. Mountain goat and moose are the two wildlife VCs that have the possibility of being affected. The potential effect was considered negligible for moose due to the low amount of moose that occur in the study area in combination with minimal to no new access overlapping with suitable moose habitat. Facilitated predation was not considered relevant for mountain goat because they use steep, rocky outcrops as suitable habitat in order to avoid predation. The Access Road, Haul Road, and the Mine Site will not enable access to the steep rocky outcrops that goats prefer as suitable habitat.

16.5.3.6 Chemical Hazards

Chemical hazards include the potential effects of any Project-related chemicals that may cause adverse health effects on Wildlife VCs. Exposure to chemical hazards may occur via uptake from the surrounding environment (e.g., water, dust, soil, or sediment) or via the ingestion of contaminated tissue (e.g., vegetation or animal prey). Exposure may also occur via direct contact with chemical hazards on-site. Chemical hazards related to Project activities may persist within and adjacent to the Project footprint following the Post-Closure Phase. This potential effect may occur during all Project phases and is considered a potential effect for all Wildlife VCs.

16.5.3.7 Attractants

Attractants include the potential effects of any Project-related features or materials that may interest or provide resources for Wildlife VCs, which could lead to behavioural changes and potential human-wildlife conflicts. Project features or materials that may attract wildlife include infrastructure where odours or food sources associated with petroleum products, food waste and associated domestic garbage, or grey water and sewage may be present. Project infrastructure may also provide refuge or shelter for small mammals or perching, nesting, or roosting sites for bats and birds. Waterbirds and amphibians may be attracted to on-site holding ponds or roadside pools as stop-over, foraging, or breeding sites, and amphibians may also be attracted to road surfaces during the summer that retain heat after sunset. Vegetation growing along Project roads or within the Powerline right-of-way (ROW) may attract grazing or browsing wildlife, while roadkill carcasses along Project roads may attract scavenging wildlife. Wildlife may also be attracted to salt on Project roads used for de-icing or dust suppression, and Project roads and the Powerline ROW may create favorable travel corridors. Once production is completed, all Project components will be removed and reclaimed and the potential effects of attractants would cease. There is an exception in that if bats gain access to underground infrastructure for maternal roosting or hibernation, their access must remain unobstructed and they must be protected from harm.

This potential effect may occur from the Construction Phase through to the Closure and Reclamation Phase and is considered a potential effect for all Wildlife VCs.

16.6 Mitigation Measures

Results from the review of best management practices, guidance documents, and mitigation measures conducted for similar projects, as well as professional judgment for the Project-specific effects and most suitable management measures, were considered in determining the mitigation measures. The approach to the identification of mitigation measures subscribed to the mitigation hierarchy, as described in the Environmental Mitigation Policy for British Columbia (http://www.env.gov.bc.ca/emop/). Technical and economic feasibility constraints dictated the highest level on the hierarchy that could be achieved for each potential effect and the identification of mitigation measures for managing these effects. The need for any proposed compensation or offset is identified where required, along with the management plan where the scope of such compensation or offset is described.

16.6.1 Key Mitigation Approaches

Key mitigation measures proposed to manage, mitigate, and/or monitor the potential adverse effects of the Project on Wildlife and Wildlife Habitat are summarized below. For the purposes of this assessment, mitigation measures included any action or Project design feature that will reduce or eliminate potential effects on Wildlife and Wildlife Habitat. If mitigation measures were considered entirely effective, potential Project-related effects to Wildlife and Wildlife Habitat were not identified as residual effects. Key mitigation approaches include:

- Design Mitigation; and
- Best Management Practices (BMPs).

16.6.1.1 Project Design

The current development plan for the Project was the outcome of a rigorous alternatives assessments process whereby IDM considered several criteria to determine an optimal development plan given technical, economic, environmental, and social parameters. Input received from the public, Aboriginal Groups, government agencies, and stakeholders during the consultation process was considered in the alternatives assessments. Refer to Volume 2, Chapter 4 for a summary of Alternative Means of Undertaking the Project.

Each element of mitigation during design of the Project is rated as high in effectiveness because they result in planned avoidance and limitation of the extent of the Project footprint and its impacts. The uncertainty is rated as low because these measures have been successfully applied in similar situations.

16.6.1.1.1 Site and Route Selection

The Project footprint was minimized and contained within one watershed (i.e., Bitter Creek) and existing infrastructure and roads were used where practicable, which will minimize habitat loss and alteration. Project infrastructure was also situated to avoid sensitive habitats (e.g., riparian areas, wetlands, steep slopes, mature/old forest) and important wildlife habitat features (e.g., natal/denning sites, nests, mineral licks, wildlife trees) whenever possible, which will minimize habitat alteration and sensory disturbance. The design of the Access Road and Haul Road was optimized to minimize the distance travelled, which will reduce noise, dust, and emissions associated with construction and operation.

16.6.1.1.2 Project Infrastructure

- The Powerline will be designed and situated following guidelines for bat and bird protection to minimize strikes and electrocutions (APLIC 2006). Measures will be taken to discourage birds, particularly raptors, from nesting on power poles.

- The mine portals and underground workings will be designed to minimize the potential for bats to gain access. Measures will also be taken to reduce the risk of bats gaining access to underground infrastructure, such as tight mesh and use of artificial light and motion. If bats gain access and use the substructure for maternal roosts or hibernacula, adaptive measures will be incorporated for their protection and continued access, and FLNRO will be contacted and made aware of the use.

- Emission reduction measures
  - The ventilation systems for the underground mine will be designed to dilute and remove dust, diesel emissions, and blasting fumes, and will maintain compliance with BC mine regulations.
  - Tailings disposal methods have been designed to reduce beach / dust sources and generation. The operational supernatant pond volume in the TMF will be managed to ensure that the beaches are saturated, which will reduce the potential for dust generation. Refer to the Tailings Management Plan (Volume 5, Chapter 29) for further details.

16.6.1.1.3 Progressive Reclamation

IDM will undertake progressive reclamation activities throughout the life of the Project. Project components will be decommissioned and removed at the end of their useful life and waste rock temporarily stored at the surface will be placed underground as backfill. TMF closure and rehabilitation activities will also be carried out progressively during the Operation Phase whenever possible. An early and progressive approach to reclamation will result in habitat suitability returning to pre-disturbance conditions and will reduce the duration of habitat alteration, sensory disturbance, and disruption to movement.

16.6.1.2 Wildlife Education Program

A Wildlife education program will be developed to increase awareness of IDM's commitment to the protection of Wildlife and Wildlife Habitat. The program will be provided to all employees, contractors, and site visitors through all phases of the Project and will be delivered in conjunction with the Project's site orientation. Records will be kept to document completion of the program by all employees, contractors, and site visitors. The objectives of the program will be to ensure awareness of wildlife-related issues and appropriate mitigation measures to reduce human-wildlife conflicts. Site personnel and visitors will receive an introduction to basic wildlife-related information applicable to the Project (e.g., bear safety training), an overview of relevant wildlife mitigation measures, and an awareness of enforcement measures and the consequences of a failure to follow wildlife mitigation measures. Access Road restrictions and operating protocols (e.g., wildlife ROW, speed limits, check-ins, road-wildlife reporting programs) will be covered during the education/ orientation. Employees will be educated to assess and adaptively manage driving activities during crepuscular hours (i.e., dawn and dusk), which are periods of high wildlife activity. A wildlife sighting log will be maintained by on-site personnel through all phases of the Project, and all wildlife collisions will be reported to IDM environmental staff. Wildlife BMPs and policies are outlined in the Wildlife Management Plan (WMP; Volume 5, Chapter 29).

16.6.1.3 Wildlife Protection Protocols

IDM will implement wildlife protection protocols that will reduce the risk of human-wildlife conflicts in the Project area and help ensure the safety of all employees, contractors, and site visitors while minimizing potential wildlife injuries or mortalities. Refer to the WMP (Volume 5, Chapter 29) for further details.

This mitigation measure is rated as high in effectiveness because it comprises preventative measures that have a high chance of success. There is low uncertainty of that effectiveness because this has been successfully applied in similar projects.

Waste management will be strictly enforced to prevent attracting wildlife. Mitigation measures to be implemented include:

- Bear-proof receptacles will be used for all waste and wildlife attractants, where possible, to ensure wildlife does not have access to temporary on-site waste storage areas, contaminated areas, and attractants.
- Training will be delivered to all workers in wildlife management protocols, including garbage management and bear encounter protocols.
- If water or waste could pose a risk to wildlife, appropriate measures will be taken to exclude wildlife from these areas (e.g., fencing, noise-makers).
- A policy of no feeding and no intentional attraction of wildlife will be developed, disseminated to all Project and contractor employees during employee orientation, and enforced.
- A policy of no littering will be developed, implemented, and enforced throughout the life of the Project and will be disseminated to all Project and contractor employees and consultants during employee orientation.
- Harassing, approaching, or otherwise interfering with wildlife will be prohibited, such as chasing wildlife with a motorized vehicle.
- Fishing and hunting by Project employees, contractors, and consultants will be prohibited. Personal firearms will be prohibited from the Project site; the only exception may be individuals authorized to have registered Company firearms for predator protection. Individuals who have existing rights to hunt, trap, and/or fish in the Bitter Creek valley may also be exempt.
- In the event of a bear encounter, bear deterrents will be employed first (e.g., bear spray, air horn); firearms will only be used as a last resort when all other deterrents have failed. If a bear is killed in defense of life or property, the BC Conservation Officer Service will be notified and consulted regarding proper disposal of the dead animal.
- All bear interactions and incidents will be recorded and reported in a yearly report as part of the WMP (Volume 5, Chapter 29).
- Appropriately trained personnel will monitor and evaluate human-wildlife conflicts carefully using the protocol for human-wildlife interactions to determine whether an animal should be considered a problem animal and the appropriate course of action.
- Wildlife will be deterred from the TMF, holding ponds, and onsite settling sumps.

16.6.1.4 Minimize Habitat Disturbance

Habitat alteration and sensory disturbance results from vegetation clearing, ground disturbance, and other Project-related activities that occur adjacent to wildlife habitat. Minimizing vegetation clearing, ground disturbance, and other Project-related activities as much as practicable within the Project footprint, maintaining sensitive habitat features (e.g., natal/denning areas, nests, maternal roosts, wildlife trees, mineral licks, hibernacula, wetlands), and avoiding disturbance during sensitive periods for wildlife will reduce habitat alteration and sensory disturbance. Sensitive habitat features may require specific disturbance management protocols, such as no-disturbance buffers. The mitigation measures listed below will be implemented to minimize habitat disturbance to wildlife. Many of these measures are related to the pathway components for Air Quality (Chapter 7) and Noise (Chapter 8) that informed assessment of potential Project effects to Wildlife VCs.

This mitigation measure is rated as moderate in effectiveness because where wildlife features are identified, and when it is possible to avoid sensitive time periods, the measures to reduce disturbance have a high chance of success. There is low uncertainty of that effectiveness because this has been similarily applied in comparable projects.

Refer to Chapter 29 (Management Plans) for further details of these mitigation measures:

- Project activities will be restricted to the defined Project footprint. Construction Phase and Operation Phase activities, including vehicle use, will be restricted to areas that are surveyed, approved, marked, and flagged. Due care will be taken by all personnel to avoid excessive and unnecessary disturbance to existing riparian and aquatic areas, vegetation and wildlife habitat within the Project footprint. The creation of new access to alpine areas within known goat ranges will be minimized.

- Prior to site preparation or construction works, Project footprint boundaries and known wildlife habitat features or sensitive areas will be clearly marked on site plans and in the field by a Qualified Environmental Professional (QEP) and will include appropriate no-disturbance buffers.

- Infrastructure (including the Access Road) shall be designed in a manner that minimizes the footprint of disturbance in order to minimize habitat loss for wildlife.

- Whenever possible Project roads and road embankments will be constructed in a manner to minimize the potential to act as physical barriers or filters to wildlife movement.

- Project infrastructure will be designed to avoid, where practicable, identified wildlife sensitive areas. Wildlife sensitive areas will be identified by a QEP and provided to Project design engineers.

- The clearing of vegetation and soil will be minimized to the extent possible, and avoided where practicable for unique features identified by QEPs, including wetlands, exposed bedrock, cliffs etc., which often provide high value habitat to wildlife and may support sensitive vegetation communities and growth forms.

- Sensitive habitat features will be maintained whenever possible. Appropriate no-disturbance buffers will be established by a QEP around sensitive habitat features when Project-related activities occur adjacent to these features.

- Habitat disturbance will be avoided during sensitive periods for wildlife. If disturbance cannot be avoided during sensitive periods, a QEP will conduct pre-clearing surveys for target species (e.g., bird nests, active grizzly bear dens, marmot dens, bat roosts) to reduce the risk of wildlife injuries or mortalities.

- Vegetation clearing and construction activities will be timed to avoid sensitive habitats during sensitive periods for Wildlife VCs (e.g. mountain goat, grizzly bear, marmot, and migratory birds) whenever possible. If construction cannot be scheduled outside of sensitive periods for Wildlife VCs, a QEP will conduct species-specific pre-clearing surveys within suitable habitat and mitigation measures will be developed.

- If a nest is identified during pre-clearing surveys or incidentally during other field activities, an appropriate no-disturbance setback will be established around the nest to minimize sensory disturbance and will remain in place until the nestlings have successfully fledged.

- Pre-clearing surveys for active grizzly bear den sites will be conducted in suitable habitats prior to any planned fall, winter, or early spring vegetation clearing or ground disturbance or any other activity that could potentially disturbed or destroy an active den. Any identified active den site will be left undisturbed and a no-disturbance buffer will be established around the active den until the den is vacated in spring.

- Pre-clearing surveys for active marten dens will be conducted within high quality suitable habitat if clearing activities are scheduled within the birthing and rearing periods, which occur from March to May. Any identified active den site will be left undisturbed and a no-disturbance buffer will be established around the den site until the den is vacated.

- Directed/focused lighting will be used where possible rather than broad area lighting to minimize sensory disturbance to wildlife. Timer systems will be considered, where appropriate, to limit light disturbance and reduce power consumption. Light in non-essential areas will only be used when necessary without compromising worker safety. Types of illumination should be light-emitting diode (LED) if possible since they produce little heat and have more focused light spectrums that are less appealing to insects and thus do not attract bats.

- Equipment will be fitted with appropriate mufflers and silencers that meet manufacturers' recommendations for optimal attenuation.

- To minimize dust emissions, speed restrictions will be imposed on all Project roads, dust suppression techniques will be used on Project roads as necessary, and loads carried by haul trucks will be enclosed or covered whenever possible. Where possible use of wildlife-attracting dust suppressants will be avoided. Refer to the Air Quality and Dust Management Plan (Volume 5, Chapter 29) for further details.

- To minimize exhaust emissions, vehicles and equipment will be regularly maintained and no unnecessary idling of vehicles or equipment will be permitted.

- Aircraft operations will be managed to minimize sensory disturbance to wildlife. Pre-determined flight paths will be developed to provide horizontal as well as vertical buffer distances between flight paths and sensitive habitats. For mountain goat habitats these include 400 m vertical and 2,000 m horizontal separation (Management Plan for the Mountain Goats in British Columbia; MGMT 2010). If provincial standard buffers cannot be feasibly implemented a site-specific mitigation plan will be developed by a QEP. Low-level helicopter flight paths will be avoided near colonies of birds during sensitive periods (e.g., staging and nesting periods). Refer to the Wildlife Management Plan (Volume 5, Chapter 29) for additional details.

- Above-ground blasting operations will be managed to minimize sensory disturbance to sensitive wildlife receptors. For example, above-ground blasting will be halted when mountain goat are observed from the ground within 1,000 m of the blast area. Whenever possible during construction, blasting will be scheduled outside of the November 1 to July 15 critical and cautionary periods for mountain goat. If this is not feasible, mountain goat presence at suitable habitat will be identified prior to blasting by ground-based surveys during November 1 to July 15.

- Where blasting is planned between March 1 and September 15, northern goshawk and cliff-nesting raptor presence within suitable habitat areas will be identified prior to blasting by ground-based surveys. If a raptor nest is successfully occupied adjacent to an above-ground blasting site, blasting patterns will be altered to limit the effects on raptors or blasting will be delayed in that area until after the nesting period. Raptor presence will be assessed in the ZOI prior to blasting during the nesting period.

- If above-ground blasting is required within a no-disturbance buffer around a sensitive wildlife receptor, a site-specific mitigation plan will be developed in consultation with a QEP and appropriate authorities.

16.6.1.5 Reduce Barriers or Filters to Movement

Project infrastructure and activities may create physical or sensory barriers or filters to wildlife movement between daily or seasonal habitats. The following mitigation measures will be implemented to reduce barriers or filters to movement. Refer to the WMP (Volume 5, Chapter 29) for further details.

- Whenever practicable Project roads and road embankments will be constructed in a manner to minimize the potential for Project roads to act as physical barriers or filters to wildlife movement.

- Snow bank height along Project roads will be managed and will include periodic breaks to minimize the potential for Project roads to act as physical barriers or filters to wildlife movement. Creating escape pathways (i.e., gaps) in snowbanks will allow wildlife (e.g., moose) to exit road areas. Project traffic will be minimized to the greatest extent practicable, which will reduce sensory barriers or filters to movement along or over Project roads.

- If migration routes for western toad are identified that cross the Access Road or Haul Road, access would be facilitated using drift fences or other means to direct toads through passages, such as culverts.

This mitigation measure is rated as moderate in effectiveness because it allows access but does not completely avoid a partial barrier to movement. There is low uncertainty of that effectiveness because this has been similarily applied in comparable projects.

16.6.1.6 Manage Vehicle Traffic

The Access Road will be a radio-assisted, single-lane, gravel road with intervisible pullouts and will be approximately five metres wide. The following mitigation measures will be implemented to manage Project-related vehicle traffic and minimize sensory disturbance and direct mortality risk due to wildlife-vehicle collisions. Refer to the WMP and Access Management Plan (both located in Volume 5, Chapter 29) for further details.

- Project traffic will be minimized to the greatest extent practicable. Crew changes will take place via shuttle on a daily basis. Freight and fuel will be routinely hauled to site; hauls trucks will travel in scheduled convoys whenever possible. The use of high-volume haul trucks for ore and waste rock transport will minimize the number of trips required between the Mine Site and Bromley Humps.

- Where possible, roads will be designed with clear lines of sight to increase the ability of drivers to see wildlife or other hazards.

- Maximum speed limit of 50 km/h will be established to minimize risk of wildlife collisions.

- Vegetation along Project roadsides will be mowed/brushed as necessary to ensure visibility of wildlife and reduce the risk of wildlife-vehicle collisions.

- Wildlife will be given the right of way on all Project roads.

- Measures will be implemented to minimize potential Project effects in identified high-quality wildlife habitats and movement corridors, including signage along Project roads in high-value wildlife areas or known wildlife travel corridors to warn vehicle operators of the potential to encounter wildlife.

- All Project roads will be closed to the public, including private vehicles (snowmobile, all-terrain vehicles, etc.) and all foot traffic, with the possible exception of individuals with existing rights to access the Bitter Creek valley. Project road use will be restricted only to persons required for Project construction, operation, and maintenance.

This mitigation measure is rated as moderate in effectiveness because it reduces but does not completely prevent possible disturbance to wildlife. There is low uncertainty of that effectiveness because this has been similarily applied in comparable projects.

16.6.1.7 Prevent Wildlife Entrapment

Wildlife may be attracted to Project roads or infrastructure for various reasons and may become entrapped, which could lead to wildlife injuries or mortalities. The following mitigation measures will be implemented to prevent wildlife entrapment. Refer to the WMP (Volume 5, Chapter 29) for further details.

- Project roads may provide favorable travel corridors for wildlife during winter. As such, snow banks along Project roads will be managed and maintained to less than one metre in height where possible and will include periodic breaks to minimize the potential for Project roads to act as physical barriers or filters to wildlife movement.

- Buildings will be designed and maintained to exclude wildlife. Deterrents (e.g., fencing, noise makers, wire barricades) will be used to discourage wildlife from entering Project infrastructure for refuge, shelter, nesting, or roosting opportunities and potentially becoming entrapped.

- Deterrents (e.g., fencing, noise makers) will be used to prevent wildlife from becoming entrapped in on-site settling sumps, holding ponds, or the TMF.

This mitigation measure is rated as high in effectiveness because there is a high likelihood of success that a physical barrier, or deterrents used as appropriate, will prevent the low chance of entrapement. There is low uncertainty of that effectiveness because this has been similarily applied in comparable projects.

16.6.1.8 Manage Chemical Hazards

The following mitigation measures will be implemented to reduce the risk of chemical hazards adversely affecting wildlife. Refer to the WMP (Volume 5, Chapter 29) for further details.

- Equipment will be properly maintained.

- All hydraulic equipment will be inspected once per shift by the operator for potential leaks.

- Fuel will be stored on-site in an Enviro-Tank. Surface mobile equipment will fuel up at this tank while fixed equipment will be supplied by fuel truck. Appropriate containment measures will be implemented to avoid spills. Refer to the Fuel Management Plan and Spill Contingency Plan (both located in Volume 5, Chapter 29) for further details.

- Explosives will be stored on-site in approved explosive magazines. Blasting activities and handling of explosives during road construction will avoid spillage and minimize ammonium blasting residue to lower potential for ammonium contamination. Refer to the Explosives Management Plan (Volume 5, Chapter 29) for further details.

- Hazardous materials (e.g., used batteries, petroleum product containers, grey water and sewage, contaminated soil or snow) will be handled, stored, transported, and disposed of in accordance with the *Transportation of Dangerous Goods Act* and associated regulations to ensure the safety of workers and the environment. Hazardous materials will be transported off-site for disposal at approved facilities. Refer to the Hazardous Materials Management Plan (Volume 5, Chapter 29) for further details.

- Cyanide will be used in a manner consistent with the International Cyanide Management Code (ICMI 2015). Cyanide will only be used to recover gold and the Process Plant will incorporate cyanide detoxification prior to release to the TMF. Cyanide-containing effluent will be analyzed and treated as required prior to discharge to the receiving environment to ensure cyanide concentrations are below the maximum authorized limits as outlined in the Metal Mining Effluent Regulations (2002) under the federal *Fisheries Act* (1985). Refer to the Hazardous Materials Management Plan and Tailings Management Plan (both located in Volume 5, Chapter 29) for further details.

- Contact water will be intercepted and routed to on-site settling sumps, holding ponds, or the TMF. Contact water will be analyzed and treated as required to meet BC water quality guidelines prior to discharge to the receiving environment. Sources of contact water include mining areas, mine wastes, tailings, and surface water/stormwater flow from the individual Project areas. Refer to the Site Water Management Plan and Tailings Management Plan (Volume 5, Chapter 29) for further details.

- Waste rock from underground mine development will be temporarily stored at a surface location adjacent to the portals during the pre-production stage of operation, but will be reclaimed within a year and placed underground as backfill. No further surface storage will be necessary beyond this point and following mine closure, the underground mine will be flooded, and the portals and ventilation raises will be collapsed or blocked. Refer to the Hazardous Materials Management Plan (Volume 5, Chapter 29) for further details.

This mitigation measure is rated as high in effectiveness because there is a high likelihood of success. There is low uncertainty of that effectiveness because this has been similarily applied in comparable projects.

16.6.1.9 Manage Attractants

To reduce human-wildlife conflicts resulting from attractants, the following mitigation measures will be implemented. Refer to the WMP (Volume 5, Chapter 29) for further details.

- General waste will be separated at the source and will be handled, stored, and transported off-site for disposal at an approved facility. Bear-proof receptacles will be used for all waste and wildlife attractants, where possible, to ensure wildlife does not have access to temporary on-site waste storage areas, contaminated areas, and attractants. Refer to the Waste Management Plan (Volume 5, Chapter 29) for further details.

- Petroleum products will be stored in holding tanks or closed facilities that exclude wildlife. Grey water and sewage will be contained in a closed system of holding tanks that will be pumped out as required.

- Deterrents (e.g., noise makers, wire barricades) will be used as necessary to discourage wildlife from using Project infrastructure for refuge, shelter, nesting, or roosting opportunities and potentially becoming entrapped.

- Deterrents (e.g., fencing, noise makers) will be used to discourage wildlife from using on-site settling sumps, holding ponds, or the TMF as stop-over, foraging, or breeding sites.

- Creation of pools attractive to amphibians along roads and within facility areas will be avoided. To discourage amphibians from congregating on road surfaces that retain heat after sunset during the summer, deterrents (e.g., fencing) will be used as necessary in high occurrence areas (e.g., along wetlands).

- Following construction of Project roads and the Powerline ROW, disturbed areas will be revegetated with a seed mixture that is less attractive to foraging wildlife.

- Seeding will use non-forage vegetation species for roadside sediment and erosion control.

- Should a carcass be found on the roadside, it will be reported and removed promptly to discourage scavenging wildlife along Project roads. The BC Conservation Officer Service will be notified and consulted regarding proper disposal of dead animals.

- Alternative measures will be used for de-icing Project roads (e.g., gravel) or dust suppression (e.g., water) whenever possible, as salt is known to attract foraging wildlife. The use of salt in traction grit for winter road management will be avoided.

- Measures will be taken to reduce the risk of bats gaining access to underground infrastructure; this includes any exploratory or existing access points not already inhabited by bats. Entrances and openings should be sourced that eliminate entry; this may include tight mesh, the use of artificial light, and motion.

This mitigation measure is rated as high in effectiveness because there is a high likelihood of success. There is low uncertainty of that effectiveness because this has been similarily applied in comparable projects.

16.6.2 Environmental Management and Monitoring Plans

IDM proposes to implement an Environmental Management System for the Project with several environmental management and/or monitoring plans (EMPs), including a WMP. The purpose of a WMP is to minimize Project-related effects on Wildlife and Wildlife Habitat during all Project phases, monitor the effectiveness of mitigation measures, and adaptively manage for any unanticipated effects resulting from Project-related activities. Other EMPs applicable to Wildlife and Wildlife Habitat are identified below. Refer to Volume 5, Chapter 29 of the Application/EIS for a description of all EMPs for the Project.

- Adaptive Management Plan;
- Access Management Plan;

- Air Quality and Dust Management Plan;
- Explosives Management Plan;
- Fuel Management Plan;
- Hazardous Materials Management Plan;
- Noise Abatement Plan;
- Site Water Management Plan;
- Spill Contingency Plan;
- Tailings Management Plan;
- Vegetation and Ecosystems Management Plan; and
- Waste Management Plan.

Environmental management will adhere to adaptive management principles. The need for adaptive management or corrective actions to on-site management or for additional control measures will be determined during the Construction, Operation, and Closure and Reclamation Phases. Refer to the Adaptive Management Plan (Volume 5, Chapter 29) for further details. Indications of the need for corrective actions or additional control measures to protect Wildlife and Wildlife Habitat may include, for example:

- Negative wildlife interactions occur that put wildlife or people at risk of death or injury;
- Results of monitoring show adverse effects to wildlife;
- Monitoring data shows an adverse effect on sensitive wildlife pathways; and/or
- Issues are raised by on-site staff, regulators, or local communities.

16.6.3 Effectiveness of Mitigation Measures

The potential effects, mitigation measures, and anticipated effectiveness of mitigation measures are summarized in Table 16.6-1. This table also identifies the residual effects that will be carried forward for residual effects characterization and significance determination. The anticipated effectiveness of mitigation measures to minimize the potential for significant adverse effects is evaluated and classified as follows within this section:

- Low effectiveness: Proposed measure is experimental or has not been applied in similar circumstances.

- Moderate effectiveness: Proposed measure has been successfully implemented but perhaps not in a directly comparable situation.

- High effectiveness: Proposed measure has been successfully applied in similar situations.

- Unknown effectiveness: Proposed measure has unknown effectiveness because it has not been implemented elsewhere in a comparable project or environment.

The timing of effectiveness of the mitigation measures varies depending on the type of mitigation. Mitigation measures that are part of the Project design or that rely on avoidance or prevention of effect through BMPs or regulatory requirements are effective immediately. Mitigation measures that are based on monitoring are dependent on the monitoring schedule. Timing related to restorative mitigation will depend on timing of vegetation regrowth to the seral stage that provides suitable wildlife habitat for each species. The implementation of Wildlife and Wildlife Habitat mitigation measures as a whole will generally provide close to immediate effectiveness.

The rationale for the proposed mitigation measures follows the hierarchy described in the Environmental Mitigation Policy for British Columbia (http://www.env.gov.bc.ca/emop/). The most effective mitigation is avoidance and the most effective modes of achieiving avoidance is during design, using preventative measures such as Wildlife Protection Protocols or Wildlife Education. When avoidance measures have been maximized (the footprint is minimized to the extent feasible and existing disturbance is utilized to the fullest extent), minimization of impact to wildlife and its habitat is the next best mitigation. Minimization and reduction of impact to wildlife and its habitat is achieved through best management practices such timing vegetation clearing to coincide outside the breeding bird window, and managing traffic to minimize the chance of collisions. Once the impacts to wildlife and habitat are avoided and minimized to the fullest extent feasible, habitat is restored progressively through the final phase of the Project. The approach to mitigation follows the hierarchy of avoid, minimize and restore.

Table 16.6-1: Proposed Mitigation Measures and Their Effectiveness

Potential Effects	Applicable Phase(s)	Mitigation Measures	Effectiveness[1]	Uncertainty[2]	Residual Effect
Mountain Goat					
Habitat Alteration	Construction	Project Design Minimize Habitat Disturbance	High Moderate	Low Low	Yes
Sensory Disturbance	All Phases	Project Design Minimize Habitat Disturbance Manage Vehicle Traffic	High Moderate Moderate	Low Low Low	Yes
Disruption to Movement	All Phases	Project Design Reduce Barriers or Filters of Movement Manage Vehicle Traffic Prevent Wildlife Entrapment	High Moderate Moderate High	Low Low Low Low	Yes
Direct Mortality	All Phases	Wildlife Education Program Wildlife Protection Protocol Manage Vehicle Traffic	High High Moderate	Low Low Low	Yes
Indirect Mortality	All Phases	Wildlife Education Program Wildlife Protection Protocol Prevent Wildlife Entrapment Manage Vehicle Traffic Access Restriction on Access Road	High High High Moderate High	Low Low Low Low Low	Yes
Chemical Hazards	All Phases	Wildlife Protection Protocol Manage Chemical Hazards	High High	Low Low	No
Attractants	All Phases	Wildlife Protection Protocol Manage Attractants	High High	Low Low	No

Potential Effects	Applicable Phase(s)	Mitigation Measures	Effectiveness[1]	Uncertainty[2]	Residual Effect
Grizzly Bear					
Habitat Alteration	Construction	Project Design Minimize Habitat Disturbance	High Moderate	Low Low	Yes
Sensory Disturbance	All Phases	Minimize Habitat Disturbance Manage Vehicle Traffic	Moderate Moderate	Low Low	Yes
Disruption to Movement	All Phases	Project Design Reduce Barriers or Filters of Movement Manage Vehicle Traffic Prevent Wildlife Entrapment	High High High High	Low Low Low Low	No
Direct Mortality	All Phases	Wildlife Education Program Wildlife Protection Protocol Manage Vehicle Traffic	High High Moderate	Low Low Low	Yes
Indirect Mortality	All Phases	Wildlife Education Program Wildlife Protection Protocol Prevent Wildlife Entrapment	High High High	Low Low Low	No
Chemical Hazards	All Phases	Wildlife Protection Protocol Manage Chemical Hazards	High High	Low Low	No
Attractants	All Phases	Wildlife Protection Protocol Manage Attractants	High High	Low Low	No
Moose					
Habitat Alteration	Construction	Project Design Minimize Habitat Disturbance	High Moderate	Low Low	Yes
Sensory Disturbance	All Phases	Manage Vehicle Traffic Minimize Habitat Disturbance	Moderate Moderate	Low Low	Yes

Potential Effects	Applicable Phase(s)	Mitigation Measures	Effectiveness[1]	Uncertainty[2]	Residual Effect
Disruption to Movement	All Phases	Prevent Wildlife Entrapment Minimize Habitat Disturbance Reduce Barriers or Filters of Movement Manage Vehicle Traffic	High Moderate Moderate Moderate	Low Low Low Low	No
Direct Mortality	All Phases	Wildlife Protection Protocols Manage Attractants Manage Vehicle Traffic	High High Moderate	Low Low Low	Yes
Indirect Mortality	All Phases	Wildlife Education Program Wildlife Protection Protocols	High High	Low Low	No
Chemical Hazards	All Phases	Wildlife Protection Protocols Manage Chemical Hazards	High High	Low Low	No
Attractants	All Phases	Manage Attractants	High	Low	No
Furbearers					
Habitat Alteration	Construction	Project Design Minimize Habitat Disturbance	High Moderate	Low Low	Yes
Sensory Disturbance	All Phases	Minimize Habitat Disturbance Manage Vehicle Traffic	Moderate Moderate	Low Low	Yes
Disruption to Movement	All Phases	Project Design Reduce Barriers or Filters of Movement Manage Vehicle Traffic Prevent Wildlife Entrapment	High Moderate Moderate High	Low Low Low Low	Yes (marten only)
Direct Mortality	All Phases	Wildlife Education Program Wildlife Protection Protocol Manage Vehicle Traffic	High High Moderate	Low Low Low	Yes (marten only)

Potential Effects	Applicable Phase(s)	Mitigation Measures	Effectiveness[1]	Uncertainty[2]	Residual Effect
Indirect Mortality	All Phases	Wildlife Education Program Wildlife Protection Protocol Prevent Wildlife Entrapment	High High High	Low Low Low	No
Chemical Hazards	All Phases	Wildlife Protection Protocol Manage Chemical Hazards	High High	Low Low	No
Attractants	All Phases	Wildlife Protection Protocol Manage Attractants	High High	Low Low	No
Hoary Marmot					
Habitat Alteration	Construction	Project Design Minimize Habitat Disturbance	High Moderate	Low Low	Yes
Disruption to Movement	All Phases	Project Design Manage Vehicle Traffic Prevent Wildlife Entrapment	High Moderate High	Low Low Low	No
Direct Mortality	All Phases	Minimize Habitat Disturbance Wildlife Protection Protocols Manage Vehicle Traffic	Moderate High Moderate	Low Low Low	Yes
Indirect Mortality	All Phases	Wildlife Protection Protocols Prevent Wildlife Entrapment	High High	Low Low	No
Chemical Hazards	All Phases	Wildlife Protection Protocols Manage Chemical Hazards Manage Attractants	High High High	Low Low Low	No
Attractants	All Phases	Wildlife Protection Protocols Manage Attractants	High High	Low Low	No

Potential Effects	Applicable Phase(s)	Mitigation Measures	Effectiveness[1]	Uncertainty[2]	Residual Effect
Bats					
Habitat Alteration	Construction	Project Design Minimize Habitat Disturbance Wildlife Protection Protocols	High Moderate High	Low Low Low	Yes
Sensory Disturbance	Construction Operation	Project Design Wildlife Protection Protocols	High High	Low Low	Yes
Direct Mortality	Construction	Project Design Minimize Habitat Disturbance Manage Vehicle Traffic	High Moderate Moderate	Low Low Low	No
Chemical Hazards	Operation Closure and Reclamation Post-Closure	Wildlife Protection Protocols	High	Low	No
Attractants	Operation Closure and Reclamation Post-Closure	Project Design Wildlife Protection Protocols Manage Attractants	High High High	Low Low Low	No
Migratory Breeding Birds					
Habitat Alteration	Construction	Project Design Wildlife Education Program Minimize Habitat Disturbance	High High Moderate	Low Low Low	Yes
Sensory Disturbance	All Phases	Wildlife Education Program Wildlife Protection Protocols Minimize Habitat Disturbance	High High Moderate	Low Low Low	Yes

Potential Effects	Applicable Phase(s)	Mitigation Measures	Effectiveness[1]	Uncertainty[2]	Residual Effect
Direct Mortality	All Phases	Wildlife Education Program Wildlife Protection Protocols Manage Vehicle Traffic Prevent Wildlife Entrapment	High High Moderate High	Low Low Low Low	No
Indirect Mortality	All Phases	Wildlife Education Program Wildlife Protection Protocols Manage Vehicle Traffic Prevent Wildlife Entrapment	High High Moderate High	Low Low Low Low	No
Chemical Hazards	All Phases	Project Design Wildlife Education Program Wildlife Protection Protocols Manage Chemical Hazards	High High High High	Low Low Low Low	No
Attractants	All Phases	Wildlife Education Program Wildlife Protection Protocols Manage Attractants	High High High	Low Low Low	No
Migratory Birds – Species at Risk					
Habitat Alteration	Construction	Project Design Wildlife Education Program Minimize Habitat Disturbance	High High Moderate	Low Low Low	Yes
Sensory Disturbance	All Phases	Wildlife Education Program Wildlife Protection Protocols Minimize Habitat Disturbance	High High Moderate	Low Low Low	Yes

Potential Effects	Applicable Phase(s)	Mitigation Measures	Effectiveness[1]	Uncertainty[2]	Residual Effect
Direct Mortality	All Phases	Project Design Wildlife Education Program Wildlife Protection Protocols Minimize Habitat Disturbance Manage Vehicle Traffic	High High High Moderate Moderate	Low Low Low Low Low	Yes (common nighthawk and marbled murrelet only)
Indirect Mortality	All Phases	Wildlife Education Program Wildlife Protection Protocols Manage Vehicle Traffic Prevent Wildlife Entrapment	High High Moderate High	Low Low Low Low	No
Chemical Hazards	All Phases	Project Design Wildlife Education Program Wildlife Protection Protocols Manage Chemical Hazards	High High High High	Low Low Low Low	No
Attractants	All Phases	Wildlife Education Program Wildlife Protection Protocols Manage Attractants	High High High	Low Low Low	No
Raptors					
Habitat Alteration	Construction	Project Design	High	Low	Yes
Sensory Disturbance	All Phases	Minimize Habitat Disturbance	Moderate	Low	Yes
Direct Mortality	All Phases	Wildlife Education Program Wildlife Protection Protocols Minimize Habitat Disturbance Manage Vehicle Traffic	High High Moderate Moderate	Low Low Low Low	No

Potential Effects	Applicable Phase(s)	Mitigation Measures	Effectiveness[1]	Uncertainty[2]	Residual Effect
Indirect Mortality	All Phases	Wildlife Education Program Wildlife Protection Protocols	High High	Low Low	No
Chemical Hazards	All Phases	Project Design Wildlife Education Program Wildlife Protection Protocols Manage Chemical Hazards	High High High High	Low Low Low Low	No
Attractants	All Phases	Wildlife Education Program Wildlife Protection Protocols Manage Attractants	High High	Low Low	No
Non-Migratory Game Birds					
Habitat Alteration	Construction	Project Design Minimize Habitat Disturbance	High Moderate	Low Low	Yes
Sensory Disturbance	All Phases	Wildlife Protection Protocols Minimize Habitat Disturbance	High Moderate	Low Low	Yes
Direct Mortality	All Phases	Project Design Manage Attractants Manage Vehicle Traffic	High High Moderate	Low Low Low	Yes
Indirect Mortality	All Phases	Wildlife Protection Protocols Manage Attractants	High High	Low Low	No
Chemical Hazards	All Phases	Wildlife Protection Protocols Manage Attractants	High High	Low Low	No
Attractants	All Phases	Manage Attractants	High	Low	No

Potential Effects	Applicable Phase(s)	Mitigation Measures	Effectiveness[1]	Uncertainty[2]	Residual Effect
Amphibians – Western Toad					
Habitat Alteration	Construction	Project Design Minimize Habitat Disturbance	High Moderate	Low Low	No
Disruption to Movement	All Phases	Project Design Reduce Barriers or Filters to Movement	High Moderate	Low Low	No
Direct Mortality	All Phases	Minimize Habitat Disturbance Reduce Barriers or Filters to Movement Manage Vehicle Traffic	Moderate Moderate Moderate	Low Low Low	No
Indirect Mortality	All Phases	Prevent Wildlife Entrapment	High	Low	No
Chemical Hazards	All Phases	Manage Chemical Hazards	High	Low	No
Attractants	All Phases	Manage Attractants	High	Low	No

[1]Effectiveness: Low = measure unlikely to result in effect reduction; Moderate = measure has a proven track record of partially reducing effects; High = measure has documented success (e.g., industry standard; use in similar projects) in substantial effect reduction

[2]Uncertainty: High = proposed measure is experimental, or has not been applied in similar circumstances; Moderate = proposed measure has been successfully implemented, but perhaps not in a directly comparable situation; Low = proposed measure has been successfully applied in similar situations

16.7 Residual Effects Characterization

16.7.1 Summary of Residual Effects

This section provides a brief summary of residual effects as identified in the last column of Table 16.6-1.

Potential effects were assessed using three measurement indicators: Habitat Availability, Habitat Distribution, and Mortality Risk. The potential residual effects are grouped under these measurement indicators for the purposes of assessment. The term "potential residual effect" refers to the sum total of potential effects under each measurement indicator as follows:

- Habitat Availability is the sum of habitat alteration and sensory disturbance.
- Habitat Distribution is the measurement of disruption to movement.
- Mortality Risk includes the sum potential effects of direct mortality, indirect mortality, chemical hazards, and attractants.

16.7.2 Methods

The assessment of potential residual effects on Wildlife VCs was characterized by using a combination of quantitative methods and qualitative discussions. Quantitative methods were used to measure habitat availability. Qualitative discussions are based on scientific literature, baseline studies, habitat models, and professional judgement and were used to measure habitat distribution and mortality risk.

16.7.2.1 Habitat Availability

Habitat availability includes changes to the amount or quality of available habitat as a result of habitat alteration or sensory disturbance. Habitat alteration and sensory disturbance were assessed quantitatively for all Wildlife VCs within the context of the RSA using habitat suitability models. Habitat modelling for the Project was based on the techniques outlined in the BC Wildlife Habitat Ratings Standards (RIC 1999a). Techniques were supplemented with current guidance, where applicable, and species-specific details are provided in Section 16.3.4.3 and Appendix 16-A.

Effective habitat was defined as the most suitable categories of habitat according to the model outputs. The highest two categories were used as effective habitat in the six- and four-class schemes, and the useable habitat category was used in the two-class scheme.

Habitat alteration or loss was assessed by calculating how much effective habitat overlapped with the Project footprint. It was assumed that all effective habitat that overlapped with the Project footprint would become unsuitable (i.e., nil suitability) for wildlife following Project construction, which is a precautionary approach because some species are likely to occupy or even frequent areas within the Project footprint polygon during the life of the Project.

Sensory disturbance was assessed by calculating how much effective habitat that overlapped with the ZOI surrounding the Project footprint would be reduced in effectiveness. See Section 16.3.4.1.4 for further definition of ZOIs. The assumption was made that habitat suitability would be downgraded by one category within the ZOI, or by a species-specific variation of this formula that is described in the following sections on residual effects assessments. The amount of effective habitat reduced due to the ZOI was added to the amount of habitat directly altered or lost due to the Project footprint. The resulting sum is the total change in habitat availability. The change in habitat availability was assessed relative to the amount of effective habitat that occurs in the RSA for each VC.

16.7.2.2 Habitat Distribution

Changes to habitat distribution include the adverse effects of Project activities and components on habitat connectivity and wildlife movements. Disruption to habitat connectivity and wildlife movements (i.e., disruption to movement) was assessed qualitatively for all VCs where it was carried through as a potential residual effect. This was evaluated qualitatively using information from the literature, baseline studies, and habitat modelling combined with a professional assessment of how this information may relate to each VC given the Project setting. Particular attention was given to local movement corridors and important habitat areas and features as identified from baseline studies and habitat modelling.

16.7.2.3 Mortality Risk

Mortality risk includes changes to wildlife mortality via direct and indirect pathways. Direct mortality includes disruption or removal of breeding sites (e.g., nests, burrows, or dens) or hibernation or maternal roosting sites for bats during vegetation clearing, ground disturbance activities, collisions with Project-related traffic on the Mine Site and Access Road, or collisions and electrocution caused by the Powerline. Indirect mortality includes increased hunting pressure (both legal and illegal) due to improved access, new travel corridors that facilitate predation, entrapment in Project facilities, such as holding ponds or in buildings or along the Access Road corridor during winter due to high snowbanks, and exposure to chemical hazards or attractants that may initiate unfavorable human-wildlife interactions.

Direct mortality risk due to the disruption or removal of breeding sites was assessed qualitatively for each VC where it was considered a potential residual effect. Direct mortality risk due to collisions with vehicles or the Powerline (bat and bird VCs only) was assessed qualitatively using information from baseline studies and habitat modelling regarding local movement corridors and important habitat areas in relation to Project roads and the Powerline. Project-related Traffic is an IC that informed the assessment potential Project effects related to mortality risk. The Traffic Impact Assessment completed for the Project regarding traffic volumes were used in this assessment (Appendix 1-C). Power line configurations and data on power line collisions were also considered in this assessment.

Direct mortality risk due to entrapment or exposure to chemical hazards or attractants were assessed qualitatively for all Wildlife VCs using information from the literature, evaluation of the potential for entrapment or exposure to occur considering Project design, and the success of proposed mitigation measures.

Indirect mortality risk due to increased hunting pressure was assessed qualitatively for large mammals, furbearers, and gamebirds by examining the current harvest regulations and rates in the Skeena region and the current status of wildlife populations within the RSA. The proposed Access Management Plan (Volume 5, Chapter 29) and firearms/hunting policy for the Project were also considered.

Chemical hazards were assessed qualitative based on where expected sources will be located with respect to suitable wildlife habitat. The VC Surface Water Quality (Chapter 13) informed the effects assessment of chemical hazards. Surface water chemistry data collected to date for the Project were reviewed in particular to inform the amphibian and bat VC assessments.

16.7.2.4 Limitations and Assumptions

Effects assessments are generally limited in the wildlife disciplines by quantitative data that provides range of natural variation in the baseline condition of wildlife habitat. The best available knowledge has been used regarding focal species biology, distribution, habitat associations, and vulnerabilities; however, some limitations and assumptions are unavoidable, as follows:

- The Project is located in a relatively remote area of the province; historic observation data are not as rich as in more highly populated or travelled areas.
- Baseline surveys for each species were completed over one or two years, as is an accepted standard for baseline investigations. Many wildlife species experience annual variability in populations that would span 10 years and longer duration.
- Uncommon, rare, or transitory species that occur within the RSA at low numbers or for short time periods may not have been detected.
- Habitat modelling is based upon the best available knowledge regarding associations between species and habitat and is limited by the current state of knowledge regarding these associations. Habitat modelling is also limited by the extent of data available in the TEM and PEM.
- Habitat modelling is based upon spatial data collected through desktop interpretation (TEM), spatial analysis (PEM), and field verification. Polygon boundaries are the best estimates of transitions between ecosystem types, but actual transitions on the ground likely vary somewhat from mapped polygons.
- Mapping and habitat modelling depends upon some publicly available data, such as the locations of streams, road networks, and glaciers. Errors in these data can lead to errors in modelling and descriptions of available habitat for some species.

16.7.2.5 Residual Effects Criteria

Residual effects were characterized using the criteria presented in Table 16.7-1.

Table 16.7-1: Characterization of Residual Effects on Wildlife

Criteria	Characterization for Wildlife
Magnitude	• **Negligible (N)**: no detectable change from baseline conditions. • **Low (L)**: differs from the average value for baseline condition but remains within the range of natural variation and below a guideline or threshold value (0-5%). • **Moderate (Moderate):** differs substantially from the average value for baseline conditions and approaches the limits of natural variation but equal to or slightly above a guideline or threshold value (6-15%). • **High (H)**: differs substantially from baseline conditions and is beyond a guideline or threshold value resulting in a potential detectable change beyond the range of natural variation (>15%).
Geographic Extent	• **Discrete (D)**: effect is limited to the Project area. • **Local (L):** effect is limited to the LSA. • **Regional (R)**: effect extends beyond the LSA but within the RSA. • **Beyond regional (BR)**: effect extends beyond the RSA.
Duration	• **Short-term (ST):** effect lasts less than 18 months. • **Long- term (LT):** effect extends beyond the Project Construction and Closure and Reclamatiom Phases. • **Permanent (P):** effect will continue in perpetuity.
Frequency	• **One time (O)**: effect is confined to one discrete event. • **Sporadic (S)**: effect occurs rarely and at sporadic intervals. • **Regular (R)**: effect occurs on a regular basis. • **Continuous (C)**: effect occurs constantly.
Reversibility	• **Reversible (R):** effect can be reversed. • **Partially reversible (PR)**: effect can be partially reversed. • **Irreversible (I)**: effect cannot be reversed, is of permanent duration.
Context	• **High (H)**: the receiving environment or population has a high natural resilience to imposed stresses and can respond and adapt to the effect. • **Neutral (N)**: the receiving environment or population has a neutral resilience to imposed stresses and may be able to respond and adapt to the effect. • **Low (L)**: the receiving environment or population has a low resilience to imposed stresses and will not easily adapt to the effect.

Magnitude was assessed quantitatively by assigning thresholds to express the relative size of habitat loss or alteration relative to the total habitat available in the assessment area. For most bird and mammal species, evidence suggests that with less than 10 to 30% of remaining suitable habitat, habitat fragmentation compounds the effects of habitat loss on population size (Andren and Andren 1994; Swift and Hannon 2010). These values largely consider the population viability or persistence of a species, which is not considered to be a conservative approach to effects assessment. Persistence and viability suggests that a population decline is acceptable as long as the population persists. These thresholds can provide a parameter for evaluating the magnitude of the Project's effects to Wildlife Habitat; however, they are adjusted to reflect the conservative approach taken in this assessment. It is acknowledged this is a generalization for all 19 species included in this assessment. The advantage of using estimated thresholds that describe each magnitude category is to provide a common point of reference for magnitude throughout the Wildlife VC assessments.

16.7.2.6 Assessment of Likelihood

Likelihood refers to the probability of the predicted residual effect occurring. The likelihood of residual effects occurring was assessed prior to the determination of significance (BC EAO 2013), but was not considered in the significance determination. The likelihood that a predicted residual effect may occur was characterized as high, moderate, or low based on the probability that a residual effect would actually be caused by the Project or how successful a proposed mitigation measure may be at reducing the residual effect (Table 16.7-2). The likelihood rating was assigned using professional judgement where quantitative data was lacking.

Table 16.7-2: Attributes of Likelihood

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

16.7.2.7 Significance Determination

The determination of whether a predicted residual effect may be significant (S) or not significant (NS) was based on the residual effects criteria presented in Table 16.7-1. Magnitude, geographic extent, duration, reversibility, and context were the primary criteria used to assess significance; frequency and likelihood were considered as modifiers where applicable. Significance characterizations were considered in context of whether the effect would result in ecological conditions that supported the existing wildlife species populations. The assessment endpoint for each wildlife VC is the maintenance of ecological conditions that support populations relative to existing baseline conditions.

The particular combination of residual effects criteria that would represent a significant adverse effect varied depending on the VC being assessed; definitions and rationale specific to each VC are provided in the following sections. Thresholds identified in scientific literature and guidance documents were used to assist with the determination of significance whenever possible. In general, residual effects determined to be significant were those that would result in a measurable adverse effect that would pose a risk to the long-term persistence and viability of a Wildlife VC at the regional level (i.e., RSA). Residual effects determined to be not significant were those that would result in a greater than negligible adverse effect, but would not meet the definition of significant. All potential residual effects were carried forward to the Cumulative Effects Assessment (CEA).

16.7.2.8 Confidence and Risk

The level of confidence associated with the residual effects predictions, and in particular how any identified uncertainties may affect either the likelihood or the significance of the predicted residual effect, was characterized as high, moderate, or low based on professional judgement of quantitative thresholds. Refer to Effects Assessment Methodology (Volume 3, Chapter 6) for definitions of each confidence rating. Potential uncertainties may include a lack of published scientific literature, the reliability of baseline data and analytical methods to predict Project effects, or the effectiveness of proposed mitigation measures.

A moderate or low level of confidence in a residual effects prediction may lead to a risk analysis if low confidence is coupled with a significant residual effect and follow-up programs are not considered sufficient. If this is the case, the process and methodology used for the analysis will be summarized and the conclusions will be explained.

16.7.3 Potential Residual Effects Assessment — Mountain Goat

Mountain goats were assessed for potential Project-related effects on habitat availability (including habitat alteration and sensory disturbance), disruption to movement, direct and indirect mortality, chemical hazards, and attractants. Following the successful implementation of mitigation measures designed to reduce the risk of chemical hazards and attractants, these potential effects were determined to have no residual effects on mountain goats and were not carried forward in the residual effects assessment. The remaining potential effects were carried forward in the residual effects assessment and detailed assessments are presented below.

16.7.3.1 Habitat Availability

Habitat availability for mountain goats was assessed for the life requisite of general living during summer (May–October) and winter (November–April) seasons (Figure 16.7-1 and Figure 16.7-2). Summer habitat availability was assessed using the PEM-based habitat suitability model developed as part of the baseline studies (Appendix 16-A). Provincially approved mountain goat UWR was used to assess winter habitat availability.

16.7.3.1.1 Residual Effect Analysis

The potential effects of the Project on habitat availability for mountain goats are summarized in Table 16.7-3. The distances used for assessment of potential sensory disturbance was 500 m (justification described in Table 16.3-5). These two distances correspond to recommended buffer distances for helicopters and ground-based industrial activity to avoid their effects on mountain goats (MGMT 2010). In this assessment, the effects of the disturbances were assumed to result in the complete loss of habitat within the ZOI. This is a precautionary assumption that is probably an overestimate of the magnitude of the effect. Some studies have observed continued use of areas by mountain goats within these ZOI distances. Locally, within the Bitter Creek valley, mountain goats have continued to occupy the area and demonstrate widespread distribution within the valley during and after helicopter-accessed mineral exploration activities over the past several years (Appendix 16-A). Potential effects are also expected to be reduced due to mitigations outlined in Section 16.6, including managing flight protocols to minimize effects from helicopters.

Table 16.7-3: Summary of Change in Habitat Availability — Mountain Goat

Habitat Type	Area of Altered Habitat (ha)	Area of Sensory Disturbance (ha)	Total Habitat Change (ha)	LSA – Total Habitat (ha)	LSA – Habitat Change (%)	RSA – Total Habitat (ha)	RSA – Habitat Change (%)
Summer Living	41	280	321	1,910	17	38,961	<1
Winter Living	1	0	1	2,275	<1	14,162	<1

16.7.3.1.2 Characterization of Residual Effect

Potential effects of the Project on habitat availability for mountain goats are adverse, driven primarily by reduction of habitat effectiveness via sensory disturbance. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The magnitude of the effect is low (less than 1%) at the RSA scale for Summer Living and low (less than 1%) at the RSA scale for Winter Living. The geographic extent of the effect is predicted to be limited primarily to the LSA; however, if goats are displaced outside of the LSA there is potential for effects at the RSA scale. The duration of the effects will be long-term, encompassing the Construction, Operation, and Closure and Reclamation Phases of the Project. The frequency of effects will primarily be continuous, corresponding to the operation of mechanized equipment; some types of disturbances will sporadic or regular. Project effects are anticipated to be fully reversible because effects are largely driven by sensory disturbance associated with mine operation. Once operations cease, adverse effects on habitat availability will be removed. Mountain goats have a low to neutral context, in terms of sensitivity or resiliency to Project effects. Although there are some cases where mountain goats have exhibited tolerance or habituation to industrial disturbances, the more consistent pattern among studies is that mountain goats avoid industrial disturbances, resulting in reduced habitat availability within the zone of sensory disturbance.

16.7.3.1.3 Likelihood

High. Adverse effects of helicopter operations and ground-based industrial activities on habitat availability of mountain goats (via reduced habitat use in response to sensory disturbance) are well documented in the literature (Foster and Rahs 1983; Côté 1996; Gordon and Wilson 2004; Goldstein et al. 2005).

16.7.3.1.4 Significance

Not Significant. Residual effects on habitat availability for mountain goats were determined to be not significant because the magnitude is low at the regional extent and the effects are reversible once mechanized activity associated with the Project ceases.

16.7.3.1.5 Confidence and Risk

Moderate. The primary uncertainty associated with the prediction is the degree to which mountain goats are actually displaced by mining operations within the sensory disturbance zones resulting in reduced habitat availability. The assumptions used in this assessment are precautionary both in terms of the sizes of the disturbance ZOIs and magnitude of effect (i.e., complete loss of habitat), and likely overestimate potential Project effects on habitat availability. There is very low risk that the Project effects could exceed those used in this assessment. More likely, goats will continue to some use portions of the sensory disturbance ZOIs and the effects will be less than those used in this assessment. This is supported by observations of goats within similar ZOIs during and after periods of exploration activity in past years (Appendix 16-A).

Figure 16.7-1: Overlap of the Project with Mountain Goat Effective Habitat — Summer Living

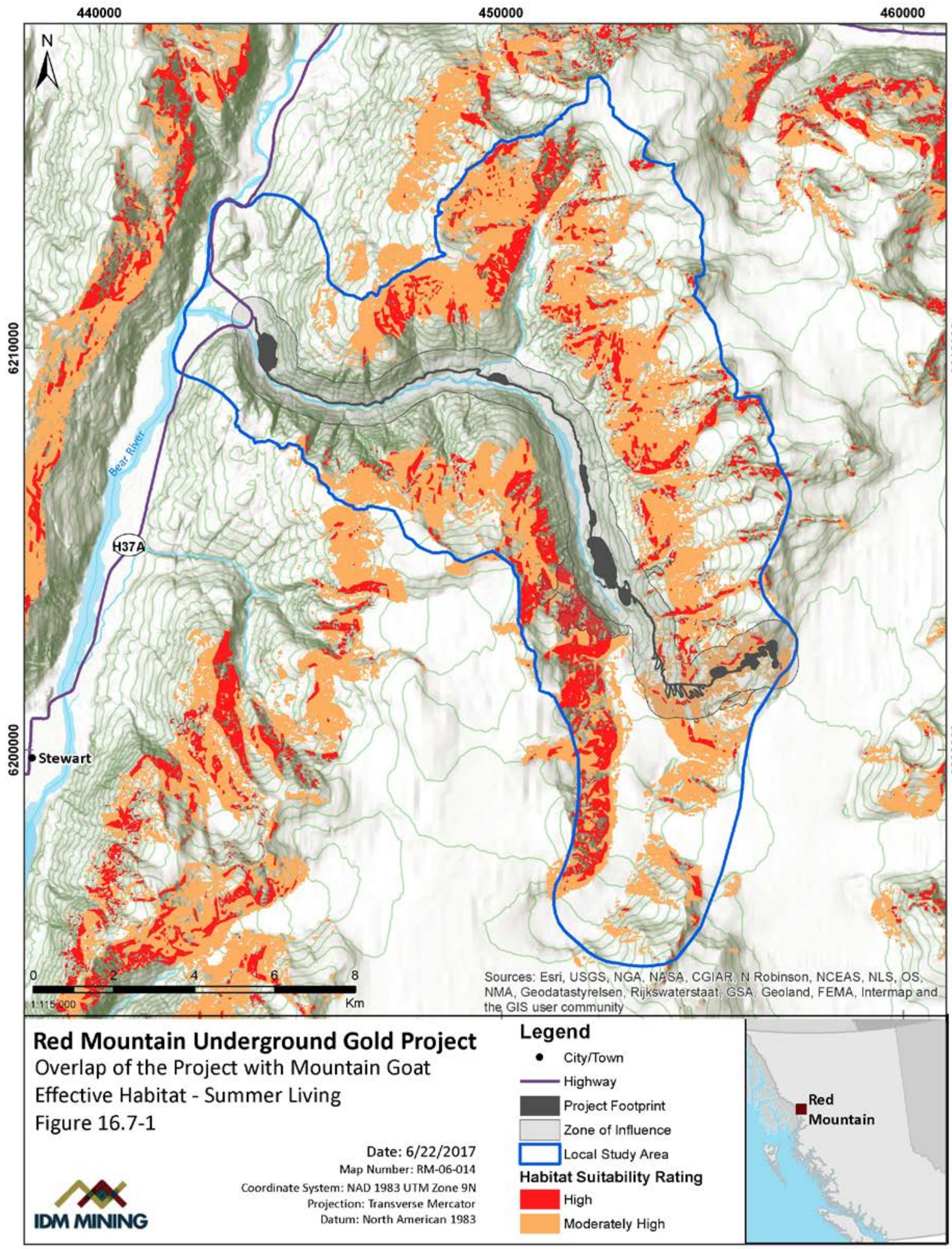
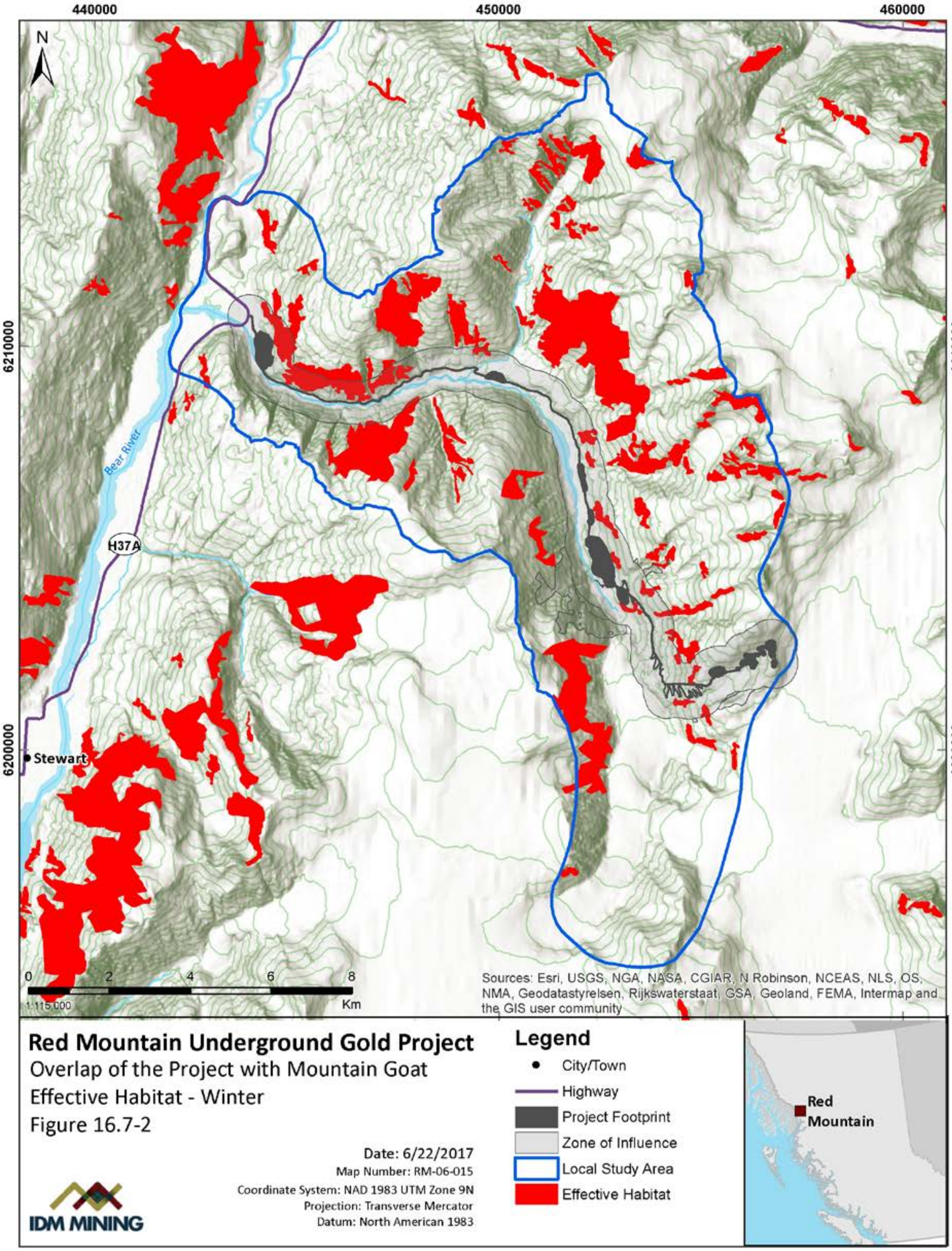


Figure 16.7-2: Overlap of the Project with Mountain Goat Effective Habitat — Winter Living



16.7.3.2 Habitat Distribution

Mountain goats require four types of habitat: winter habitat, summer habitat, natal areas, and mineral licks. Seasonal movements among these habitat types are critical to meeting annual life requisites. Distances among different habitat types and associated seasonal movement patterns vary widely among populations and geographic regions, and can include substantial differences in elevation as well as horizontal distances of up to 35 km (Nichols 1985; Poole and Heard 2003). Movement patterns of goats within the Project LSA and RSA are poorly known. Numerous goat trails have been mapped within the RSA (Figure 16.7-3), and remote camera monitoring along several of the trails recorded over 2,000 detections of goats from June 5 to August 31, 2016. However, it is unclear whether these are mostly local or regional movements.

Based on the distribution of suitable summer and winter habitat within the LSA and other portions of the RSA, it appears that goats have the opportunity to move between these two key seasonal habitat types within relatively short distances (e.g., less than 10 km) over most of the LSA and RSA. Surveys have confirmed widespread distribution of goats across the LSA and portions of the RSA in both summer and winter (Appendix 16-A). Two possible mineral licks have been located in upper Bitter Creek valley. To protect the sensitivity of licks, the precise locations remain confidential. The size, appearance, and evidence of use suggests these two features are marginal licks that receive limited local use, as opposed to being a major mineral lick that large numbers of goats make regional movements to access.

16.7.3.2.1 Residual Effect Analysis

The extent of overlap of the 500 m ground-based disturbance ZOI and the 2,000 m helicopter ZOI with known mountain trails (total length = 37,825 m) is mapped in Figure 16.7-3. The percentage overlap of the ZOIs with the trails is 16% within 500 m and 50% within 2,000 m. Over most of the length of the Access Road into the Project, along the Bitter Creek valley, the road does not cross any known trails. However, in the vicinity of the Mine Site (including the portals, ancillary facilities, and sections of switch-back road along Goldslide Creek), the Project footprint overlaps five mapped trails and is within less than 100 m of a possible mineral lick. The primary mechanism of effect on movement is expected to be sensory disturbance that could cause goats to avoid traveling within the ZOI. Physical impediments to movement are expected to be minimal once mitigation measures, such as road bank contouring and snow piling, are implemented.

Based on the spatial overlap between the Project and known goat trails, the greatest potential for effects of the Project on goat movements is expected to occur along the switch-back section of road and associated Project infrastructure along Goldslide Creek. Although that area is known to be used regularly by goats (Appendix 16-A), the importance of the area for movement is unknown. It is also unknown to what degree the development and operation of the road and mine facilities will affect movements. Although some habituation to roads and road construction has been documented (Churchill and Wilson 2008), the more general pattern is that goats avoid areas with industrial activities (MGMT 2010), which could result in reduced movement across the Goldslide area. This could result in isolation of habitat areas south of Goldslide Creek and reduction of movements between the east and west side of Bitter Creek, below the Bromley Glacier.

16.7.3.2.2 Characterization of Residual Effect

Potential effects of the Project on habitat distribution and movement for mountain goats are adverse, driven primarily by potential avoidance of existing trails due to sensory disturbance, especially in the Goldslide Creek area. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. Although trails have not been mapped outside the LSA, the magnitude of effect at the RSA scale is predicted to be low, assuming similar densities of trails observed in the LSA and associated movement occur across the RSA. The geographic extent of the effect is predicted to be limited primarily to the LSA (Local) with the greatest potential effect located within the Mine Site and Haul Road (Discreet). The duration of the effects will be long-term, encompassing the Construction, Phase, and Closure and Reclamation Phases of the Project. The frequency of effects will primarily be continuous, corresponding to the operation of mechanized equipment; some types of disturbances will sporadic or regular. Project effects are anticipated to be fully reversible because effects are largely driven by sensory disturbance associated with mine operations. Once operations cease, adverse effects on habitat distribution and movement will be removed. Mountain goats have a low to neutral context in terms of sensitivity or resiliency to Project effects. Although there are some cases where mountain goats have exhibited tolerance or habituation to industrial disturbances, the more consistent pattern among studies is that mountain goats avoid industrial disturbances, potentially affecting movement patterns among season habitats.

16.7.3.2.3 Likelihood

High. Adverse effects of helicopter operations and ground-based industrial activities on mountain goats (via displacement in response to sensory disturbance) are well documented in the literature (Foster and Rahs 1983, Côté 1996; Gordon and Wilson 2004; Goldstein et al. 2005).

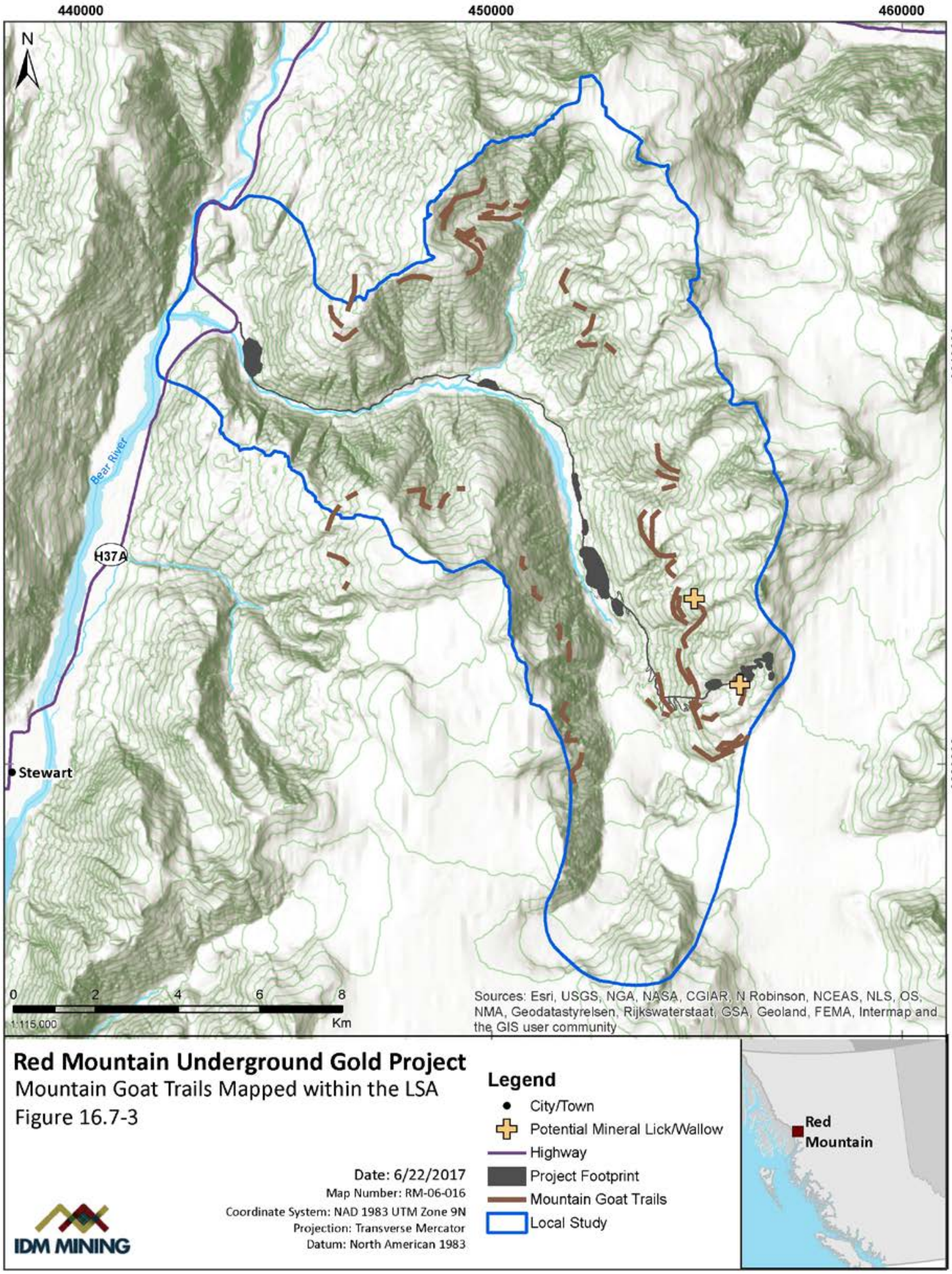
16.7.3.2.4 Significance

Not Significant. Residual effects on habitat distribution and movement for mountain goats were determined to be not significant because the magnitude is low at the regional extent and the effects are reversible once mechanized activity associated with the Project ceases.

16.7.3.2.5 Confidence and Risk

Low. Confidence in the prediction is low due to two uncertainties associated with the assessment. One uncertainty is knowledge about the scale of movements by mountain goats that are occurring through the areas. Specifically, there is uncertainty about whether relatively high rates of movement in portions of the Bitter Creek valley, including the Goldslide area, represent local or regional movements. The second uncertainty is the degree to which movements through the Goldslide area may be affected by Project effects.

Figure 16.7-3: Mountain Goat Trails Mapped within the RSA



16.7.3.3 Mortality Risk

Two potential sources of mortality risk for mountain goats are associated with the Project: new road access in the Bitter Creek valley could facilitate better access into the area for licensed and unlicensed hunters and vehicle collision risk. Specific mitigation measures to minimize mortality from these sources are outlined in Section 16.6 and, once implemented, potential mortality risk to mountain goats is predicted to be very low.

16.7.3.3.1 Residual Effect Analysis

Potential mortality risk to mountain goats associated with the Project was assessed qualitatively because data to support a quantitative assessment were not available. Potential mortality risk associated with vehicle collision risk was predicted to be limited to a very small number of individual animals over multiple years once mitigations are implemented. Mitigations will include a combination of slow speeds, signage in high wildlife areas, radio communication, and a policy of giving wildlife the right of way. At other mines these types of measures have virtually eliminated collisions with wildlife (Teck Coal Limited 2011).

Potential mortality risk associated with improved access for hunters is more difficult to predict because a component of the effect (i.e., the hunter) is outside the control of IDM. Mitigations to minimize hunting related mortality will include controlling access to the Bitter Creek valley and a no firearms, no hunting policy for employees and contractors within the LSA. While these measures should minimize the opportunity for hunters to use the new road to access goats in the Bitter Creek valley, access control measures can be circumvented by determined individuals, and a small number of goats may be killed over multiple years by hunters with unauthorized access. The potential effect is expected to be negligible following Closure and Reclamation when access is closed.

16.7.3.3.2 Characterization of Residual Effect

Potential effects of the Project on mortality risk for mountain goats are adverse, and result from improved access for hunters and vehicle collision risk. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The magnitude of the effect is predicted to be negligible to low once mitigations (access control and driving measures) are incorporated. If access control is not implemented along the new road, mortality risk associated with hunting could be elevated to moderate. The geographic extent of the effect will be limited to the LSA (Local) with collision risk being primarily limited to the section of switch-back road along Goldslide Creek (Discreet). The duration of the effects will be long-term. The frequency of effects will primarily be regular to continuous, corresponding to road access and vehicle travel along the access and mine roads. Project effects are anticipated to be partially reversible at the population level. Once operations cease, collision risk will no longer be present; however, improved access for hunters may persist after the Project ends. Mountain goats are expected to have a neutral context in terms of sensitivity or resiliency to mortality-related Project effects because the magnitude of potential effects is estimated to be so low that it will not affect the population.

16.7.3.3.3 Likelihood

Low if access control is implemented along the Access Road. However, the likelihood of increased hunter-related mortality would increase to high if the access along the new road was not controlled.

16.7.3.3.4 Significance

Not Significant. Residual effects of mortality risk for mountain goats were determined to be not significant because the magnitude is negligible to low at the regional extent.

16.7.3.3.5 Confidence and Risk

High for vehicle collision risk and moderate for increased hunter access risk. Confidence in the prediction is high for vehicle collision risk because mitigations can reduce the magnitude of the effect to a negligible level. Confidence is moderate with respect to controlling hunter access because determined individuals can circumvent access control measures. Confidence related to the effect of hunters on mortality is also somewhat reduced because there is uncertainty as to how hunting regulations may be revised to account for the new road.

16.7.4 Potential Residual Effects Assessment — Grizzly Bear

Grizzly bear were assessed for potential Project-related effects of habitat alteration, sensory disturbance, disruption to movement, direct and indirect mortality, chemical hazards, and attractants. The potential effects habitat availability (including habitat alteration and sensory disturbance) and mortality risk due to human-bear conflict were carried forward in the residual effects assessment and detailed assessments are presented below. Following the successful implementation of mitigation measures designed to reduce the risk of disruption of movement, direct morality due to collisions, indirect mortality, chemical hazards, and attractants, these potential effects were determined to have no residual effects on grizzly bear and were not carried forward in the residual effects assessment.

The rationale for the potential effects that were not determined to be residual effects is related to the Project roads, level of traffic, and the number of grizzly bear that likely overlap the Project area. Although no absolute thresholds have been determined to define a road density that is acceptable to grizzly bears (Ross 2002), roads are known to have a negative effect on grizzly bears when they reach a density of approximately 0.6 km/km^2 (BC MOE 2012). The effect gets stronger once road density increases over approximately 1.0 km/km^2 (BC MOE 2012). Currently, the road density within LSA and the RSA is 0.04 km/km^2, which is less than the negative threshold effect of 0.6 km/km^2.

A Traffic Impact Study by EcoLogic Consultants (2017; Appendix 1-C) states that, based on available data, Project-related traffic is expected to have a maximum 3% increase in overall traffic rates, and the bulk of this traffic increase will be experienced during Project operations along Highway 37A between Stewart and the Access Road. This same study states that there could be a 1% increase in vehicle collisions (includes with other vehicles and wildlife). In general, summary statistics for wildlife-vehicle collisions in BC based on 2006 – 2010 data in the North coast region, 71 bears have been involved in vehicle collisions between 2006 and 2010 (data does not differentiate between black and grizzly bear; O'Keefe and Rea 2012).

Bear density within the Stewart Grizzly Population Unit is estimated at 30 to 40 bears per 1,000 km^2. Based on this information it can be estimated that the LSA would contain five to six grizzly bears over its area of 159 km^2.

16.7.4.1 Habitat Availability

Effects to grizzly bear habitat are typically the greatest during the construction phase of development projects, especially where project components are being built and vegetated areas are being cleared. Ambient noise from Project activities especially around the Mine Site and Process Plant are considered the cause of most of the sensory disturbance to grizzly bear.

Habitat availability includes changes to the amount of habitat as a result of habitat alteration due to clearing and grubbing activities and habitat avoidance due to sensory disturbances. Habitat alteration and sensory disturbance were assessed quantitatively by calculating the amount of effective habitat that overlapped with the Project footprint and with the ZOI, respectively. The ZOI represents the area that grizzly bear would potentially avoid due to noise and was based on noise modeling for the Project (justification described in Table 16.3-5). The ZOI is approximately 735 ha and is approximately four times larger than the Project footprint.

16.7.4.1.1 Residual Effect Analysis

Grizzly bear habitat availability was assessed through habitat suitability mapping for five grizzly bear life requisites: early spring feeding, late spring feeding, summer feeding, fall feeding, and winter denning. Figure 16.7-4 to Figure 16.7-8 show where the Project footprint and ZOI overlap each season of feeding habitat for grizzly bear. The total change in habitat availability considering all five types of habitat is 2% of the effective habitat in the RSA.

The total effective early spring feeding habitat mapped in the RSA was approximately 13,858 ha and within the LSA was approximately 1,237 ha. Approximately 45 ha of effective grizzly bear early spring feeding habitat will be altered due to clearing and grubbing activities within the Project footprint, and 6 ha will be downgraded from what was considered effective habitat due to sensory disturbance. The reduction of habitat availability was less than 1% of the early spring feeding habitat in the RSA (Table 16.7-4). Approximately 9,722 ha of suitable late spring feeding habitat was mapped within the RSA and approximately 2,072 ha of suitable late spring feeding habitat was mapped within the LSA (Table 16.7-4). The amount of effective late spring habitat available is reduced by less than 1% in the RSA (Figure 16.7-5).

Of the five types of habitat mapped within the LSA, the most common is summer feeding habitat. The RSA and LSA contain approximately 41,428 ha and 5,115 ha, respectively, of mapped effective summer feeding habitat. The effective summer feeding habitat is reduced by less than 1% in the RSA (Table 16.7-4). The total effective fall feeding habitat mapped in the RSA is approximately 27,532 ha and within the LSA is approximately 1,885 ha. Effective grizzly bear fall feeding habitat will be reduced by 61 ha due to clearing and grubbing activities within the Project footprint and 112 ha of habitat would be reduced in effectiveness. This would result in reduction of less than 1% in the RSA (Table 16.7-4).

The RSA and LSA contain approximately 6,496 ha and 757 ha respectively of effective denning habitat. Reduced habitat availability results in change to less than 1% of the effective denning habitat mapped in the RSA (Table 16.7-4).

Table 16.7-4: Summary of Change in Habitat Availability — Grizzly Bear

Habitat Type	Area of Altered Habitat (ha)	Area of Sensory Disturbance (ha)	Total Habitat Change (ha)	LSA – Total Habitat (ha)	LSA – Habitat Change (%)	RSA – Total Habitat (ha)	RSA – Habitat Change (%)
Early Spring Feeding	45	6	51	1,237	4	13,858	<1
Late Spring Feeding	34	8	42	2,072	2	9,722	<1
Summer Feeding	84	120	204	5,115	4	41,428	<1
Fall Feeding	61	112	172	1,885	9	27,532	<1
Winter Denning	<1	8	8	757	1	6,496	<1

16.7.4.1.2 Characterization of Residual Effect

The overall Project related effects on grizzly bear habitat are anticipated to be minimal. Habitat alteration throughout all Project phases are deemed minimal largely because the footprint is small and does not contain large areas of high or moderately-high quality (i.e., effective habitat) feeding or denning habitat for grizzly bear. Grizzly bear may be disturbed by activities in close proximity to effective feeding or denning habitat when Project activities associated with an increase in noise are performed.

The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The residual effect resulting in changes to grizzly bear habitat availability due to Project related activities was assessed as being adverse and at a low magnitude. The effect of habitat alteration will be long-term in duration, will occur on a continuous basis, will be local in geographic extent, and is considered reversible upon successful reclamation of the Project footprint. Overall, grizzly bear have a high natural resilience to changes in habitat availability and are known to respond and adapt to this effect.

16.7.4.1.3 Likelihood

High, based on the probability that a change in habitat availability would occur regardless of the proposed mitigation measures that will be implemented to reduce the effect of reduced available habitat.

16.7.4.1.4 Significance

Not Significant. Habitat availability was considered not significant based on having a low magnitude, local in extent, and reversible in the long term. The effect of habitat alteration on grizzly bear by the Project occurs within the range of natural variation and should not cause any changes to the grizzly bear population found in the area.

16.7.4.1.5 Confidence and Risk

Moderate. There is a good understanding of grizzly bear life history requirements. The primary uncertainty is associated with the modeling predictions (model evaluations ranged from 67.5% to 87.5% depending on life requisite) and the degree of which grizzly bears are actually displaced by mining operations within the sensory disturbance zones. There is a low risk that the Project effects could exceed those used in this assessment. Grizzly bears will continue to use some portions of the sensory disturbance ZOIs and the effects will be less than those used in this assessment.

Figure 16.7-4: Overlap of the Project with Grizzly Bear Effective Habitat — Early Spring Feeding

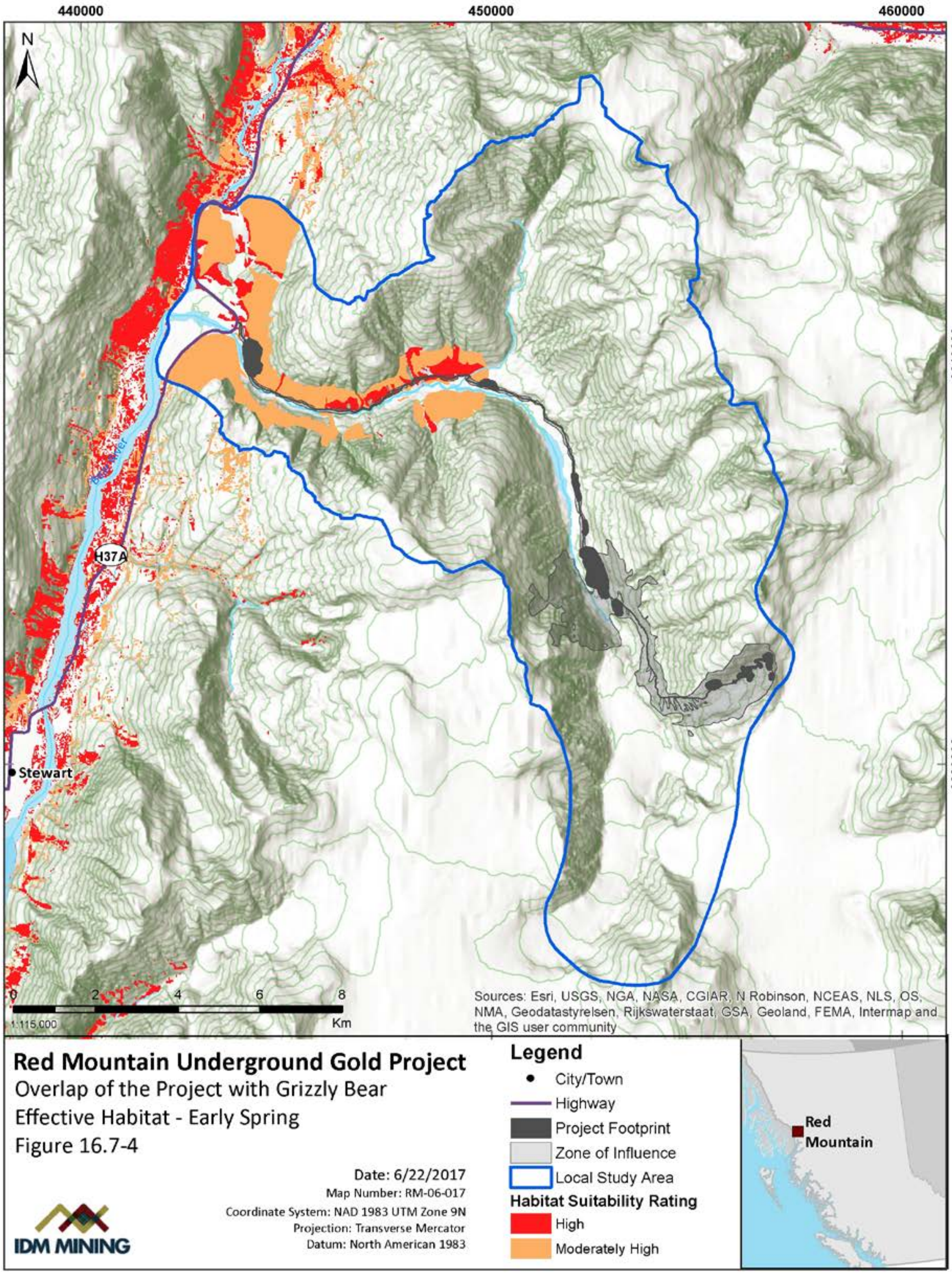


Figure 16.7-5: Overlap of the Project with Grizzly Bear Effective Habitat — Late Spring Feeding

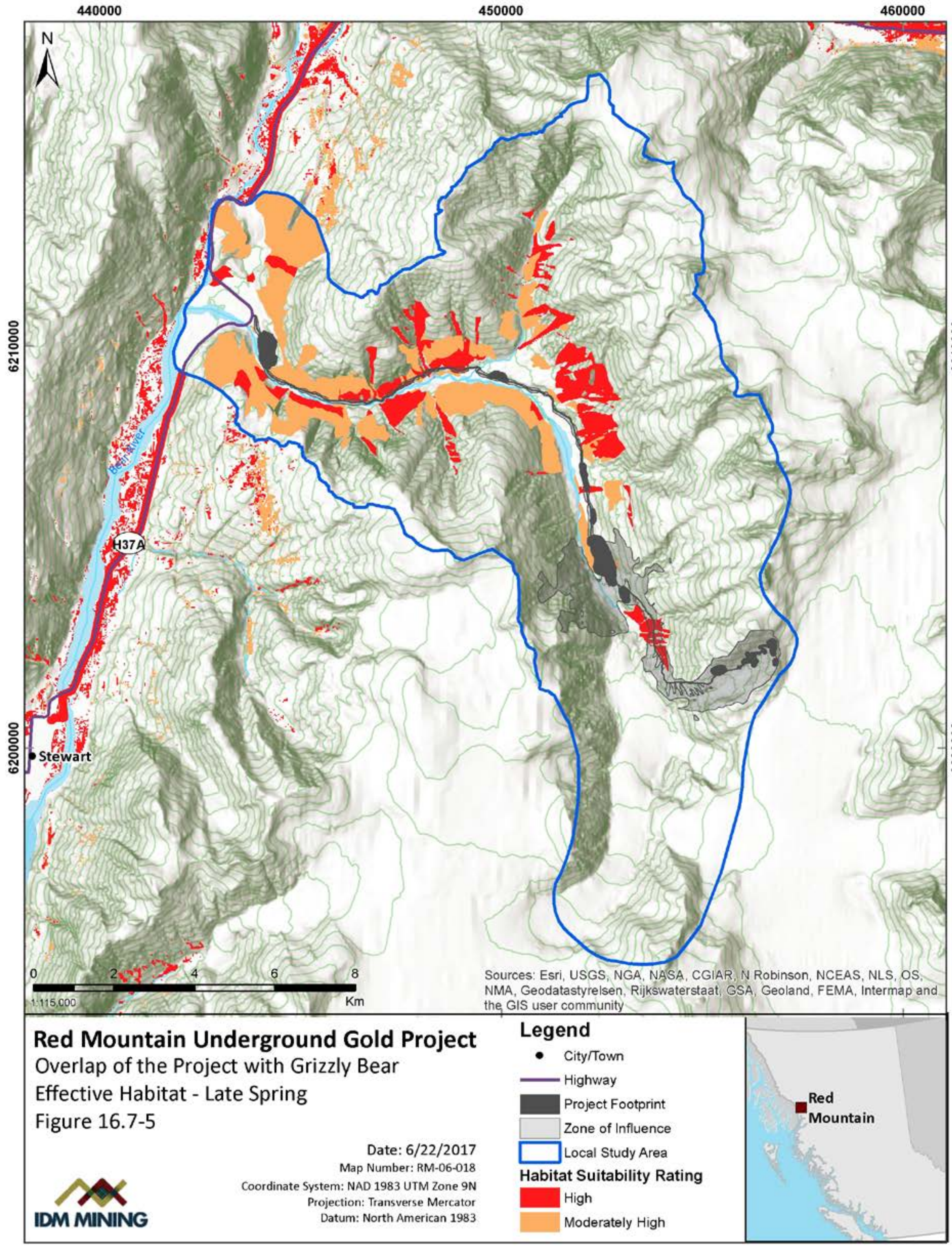


Figure 16.7-6: Overlap of the Project with Grizzly Bear Effective Habitat — Summer Feeding

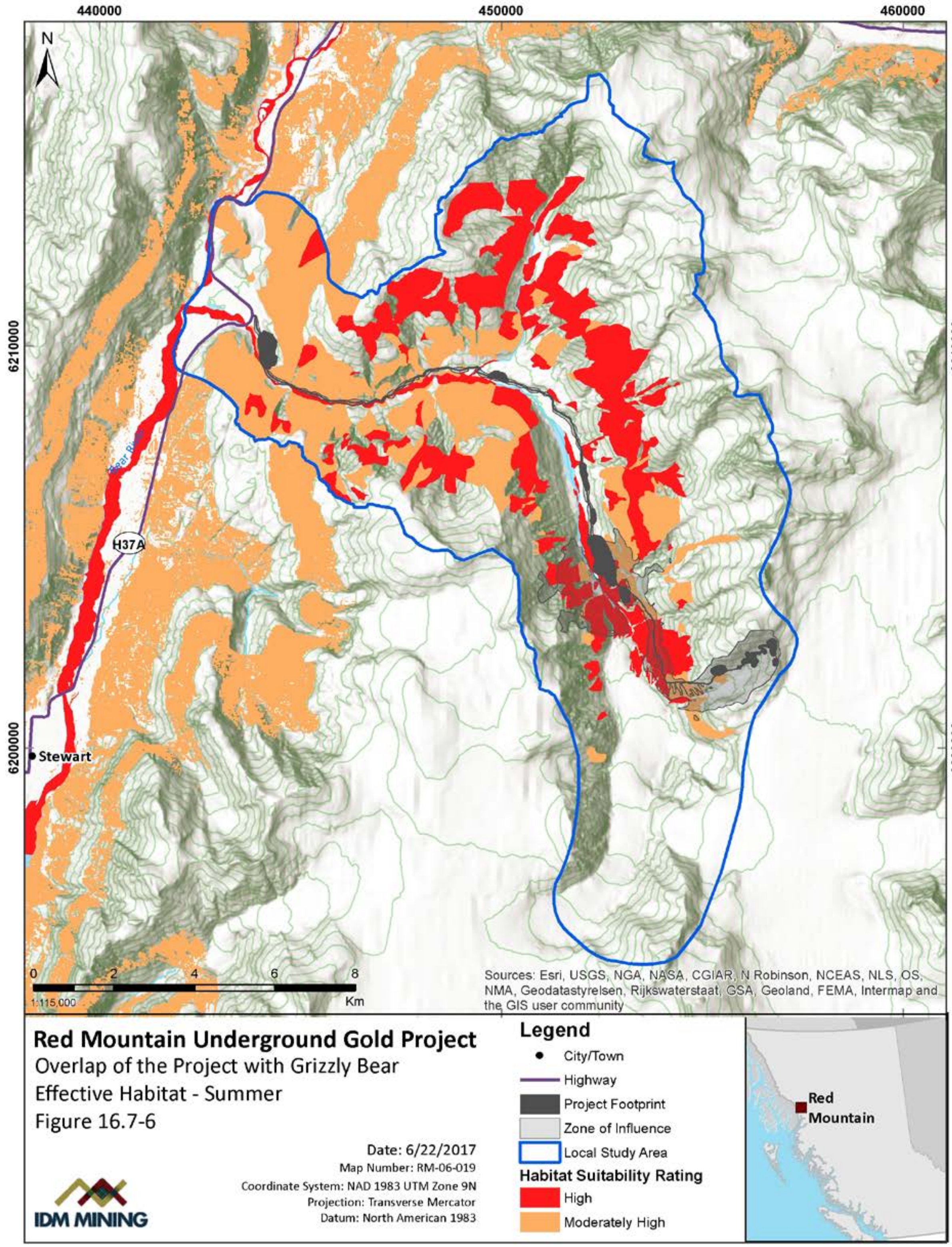


Figure 16.7-7: Overlap of the Project with Grizzly Bear Effective Habitat — Fall Feeding

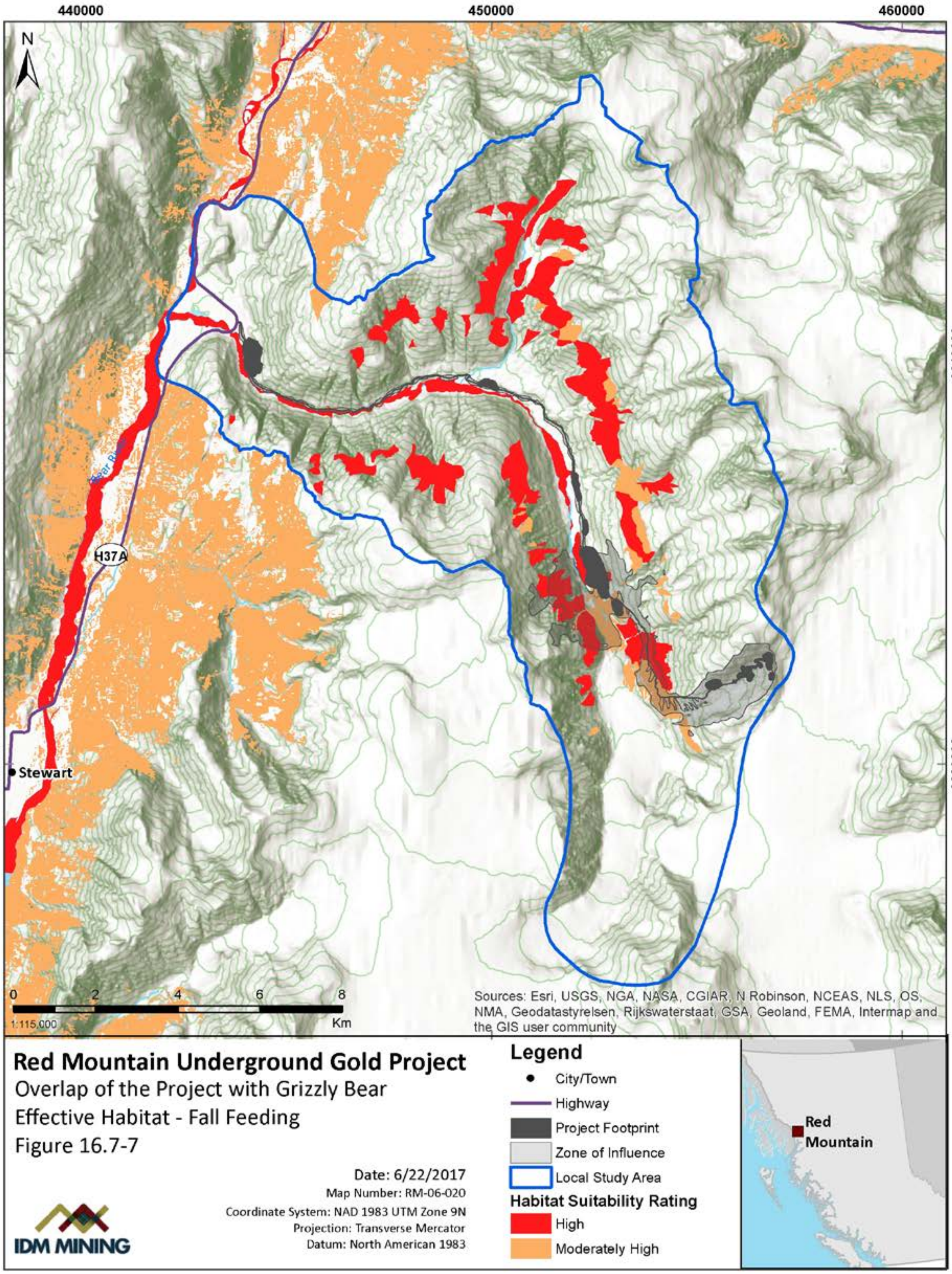
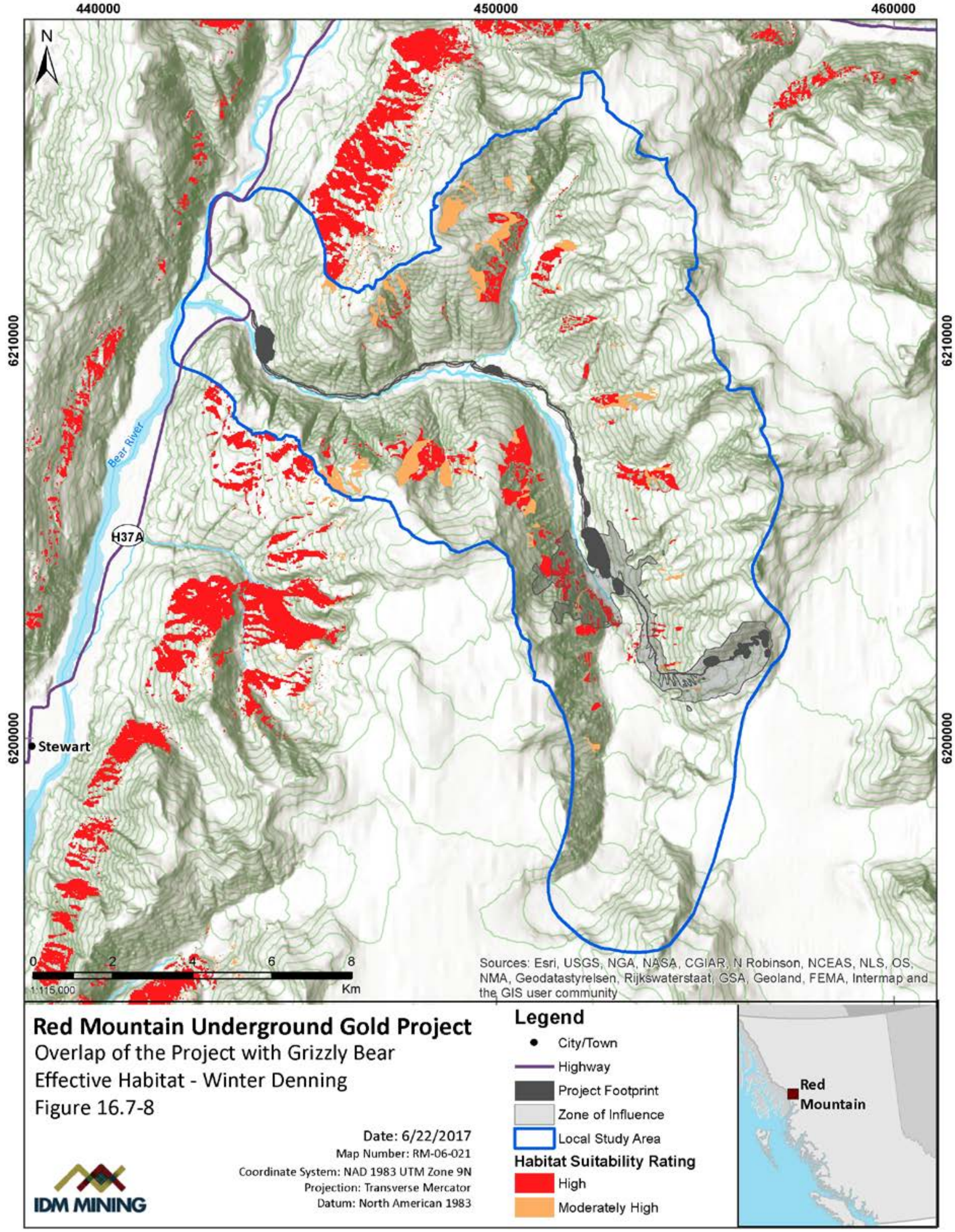


Figure 16.7-8: Overlap of the Project with Grizzly Bear Effective Habitat — Winter Denning



16.7.4.2 Mortality Risk

16.7.4.2.1 Residual Effect Analysis

Development is considered one of the greatest threats to grizzly bears in BC, primarily through increased conflicts between bears and humans and habitat displacement. Roads in the RSA currently total approximately 76 km in length. Roads are considered of particular concern to grizzly bears primarily due to increased human access, which can result in increased mortality due to conflict, hunting pressure, and vehicle collision, in addition to habitat-related effects. Human-bear conflict was the only source of mortality risk considered to be a potential residual effect on grizzly bear.

16.7.4.2.2 Characterization of Residual Effect

It is expected that the probability of grizzly bear direct mortality due to conflict with humans or vehicle collision is very low based on mitigation measures that require waste management coupled with the lack of a camp at the Project site. The probability is also low based on the baseline survey results showing low signs of grizzly activity in the vicinity of the Project. Also most personnel will be housed in accomodation in Stewart and will be transported to the Project using buses, thereby minimizing increases to traffic volumes along Highway 37A between Stewart and the Project Access Road.

The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The effect of direct mortality is considered adverse and low magnitude. In support of this determination, direct mortality will be long-term in duration, will occur at sporadic intervals, will be local as it is limited to the LSA, and is reversible once the Project is closed and access is reclaimed or closed. Overall, bear populations have good resilience to effects measured by mortality risk and are known to respond and adapt to this effect, a neutral resilience to changes in mortality for the population is considered.

16.7.4.2.3 Likelihood

Low, based on the low probability that a grizzly bear would be killed as a result of a Project related conflict since grizzly density is low within the LSA and effective mitigation measures would be in place.

16.7.4.2.4 Significance

Not Significant. The residual effect of direct mortality is considered not significant based on having a low magnitude, local in extent, and sporadic frequency. The effect of direct mortality on grizzly bear is distinguishable at the individual level but would not adversely affect the population.

16.7.4.2.5 Confidence and Risk

High. There is a good understanding of grizzly life history requirements as they relate to populations numbers and an approximate density for the overall Grizzly Bear Population Unit is known. The road density in the LSA and RSA is known and was compared to a threshold value and predicted effects are below this threshold value. There is a very low risk that the Project effects could exceed those used in this assessment.

16.7.5 Potential Residual Effects Assessment — Moose

Moose were assessed for potential Project-related effects of habitat alteration, sensory disturbance, disruption to movement, direct and indirect mortality, chemical hazards, and attractants. Following the successful implementation of mitigation measures, potential effects disruption of movement, indirect mortality risk, chemical hazards, and attractants were determined to have no residual effects on moose and were not carried forward in the residual effects assessment. The rationale is supported by the low level of moose that occur in the Project area and the small amount of suitable habitat potentially influenced by the Project (1% of the habitat in the RSA). There is a low amount of new road associated with the Project that would overlap suitable moose habitat and potentially lead to disruption of movement. No moose or signs of moose were recorded within the LSA during baseline surveys, which signify that moose are not currently using this valley on a regular basis. The remaining potential effects of habitat availability (including habitat alteration and sensory disturbance) and direct mortality were carried forward in the residual effects assessment and detailed assessments are presented below.

16.7.5.1 Habitat Availability

Assessment of habitat availability includes changes as a result of habitat alteration due to clearing and grubbing activities and habitat avoidance due to sensory disturbances. Habitat alteration and sensory disturbance was assessed quantitatively for moose by calculating how much effective habitat (i.e., habitat rated as being moderately high or high) overlapped with the Project footprint and the ZOI, respectively. The sum of the amounts is the total change in habitat availability.

Alterations to moose habitat are typically the greatest during the construction phase of development projects, especially where project components are being built and vegetated areas are being cleared. Moose can often be found living in close proximity to human settlements, and are likely habituated to human presence to some extent. However, loud noises associated with machinery, especially around the Mine Site and Process Plant, may displace moose from the most effective habitat areas to less suitable habitat. The change in habitat availability due to sensory disturbance was calculated by area using the assumption that habitat suitability would decrease by one category in the ZOI. The ZOI represents the area that moose would potentially avoid due to noise and corresponds to where the noise model predicted continuous Project noise would exceed 55 dBA during the day and 45 dBA during night (justification described in Table 16.3-5). The ZOI is approximately 735 ha and is approximately four times larger than the Project footprint.

16.7.5.1.1 Residual Effect Analysis

The RSA contains approximately 10,076 ha and the LSA contains approximately 446 ha of effective moose summer living habitat (Table 16.7-5; Figure 16.7-9). Approximately 9% of the effective summer habitat mapped in the LSA is affected due to the habitat alteration and sensory disturbance. Less than 1% of effective habitat in the RSA is affected through habitat availability.

The RSA and LSA contain approximately 1,955 ha and 172 ha, respectively, of mapped effective winter living habitat (Table 16.7-5; Figure 16.7-10). Habitat alteration and sensory disturbance will affect approximately 9% of effective winter living habitat mapped in the LSA and less than 1% of this habitat within the RSA.

Table 16.7-5: Summary of Change in Habitat Availability — Moose

Habitat Type	Area of Altered Habitat (ha)	Area of Sensory Disturbance (ha)	Total Habitat Change (ha)	LSA – Total Habitat (ha)	LSA – Habitat Change (%)	RSA – Total Habitat (ha)	RSA – Habitat Change (%)
Summer Living	26	12	38	446	9	10,076	<1
Winter Living	14	2	16	172	9	1,955	<1

Approximately 1% of summer and winter moose habitat is affected through the measurement of habitat availability in the RSA. The Project footprint will remove approximately 6% of suitable summer and winter living habitat from the LSA. The most limiting type of habitat found within the LSA is winter living habitat and the Project footprint removes 14 ha of this type of habitat due to the construction and upgrade of the Access Road from the highway turn off to the Process Plant. Most of the effective winter living habitat has been mapped adjacent to the proposed Access Road (Figure 16.7-10). During the Construction Phase, these patches of winter living habitat could be avoided especially during winter months when moose are most likely to be using this habitat. No moose or signs of moose were observed in the LSA during 2015 and 2016 surveys.

16.7.5.1.2 Characterization of Residual Effect

The overall Project related effects on moose habitat are anticipated to be minimal. Habitat alteration throughout all Project phases are deemed minimal largely because the footprint is small and does not contain large areas of high or moderately-high quality winter or summer living habitat for moose. In general, for moose like many other mammals, winter habitat is considered a limiting factor.

The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. Habitat availability for moose was assessed as being adverse and of low magnitude in the RSA. Effects on habitat availability would be long-term in duration, would occur continuously, would be local in geographic extent, and was considered reversible upon successful reclamation of the Project footprint. Overall, moose have a high natural resilience to habitat availability and are known to respond and adapt to this effect.

16.7.5.1.3 Likelihood

High based on the probability that changes to habitat availability would be caused by the Project even after the proposed mitigation measures are implemented.

16.7.5.1.4 Significance

Not Significant. Changes to habitat availability were considered not significant based on having a low magnitude at the RSA level, local in extent, long-term in duration, and reversible. The effect of Project related activities on moose habitat availability should not cause any adverse changes to moose populations in the area.

16.7.5.1.5 Confidence and Risk

High. There is a good understanding of moose life history requirements and there is a small degree of uncertainty associated with modelling techniques (habitat model evaluation ranging from 75% to 83.5% depending on life requisite). No moose or signs of moose were recorded within the LSA during baseline surveys, which signify that moose are not currently using this valley on a regular basis. There is a very low risk that the Project effects could exceed those used in this assessment.

Figure 16.7-9: Overlap of the Project with Moose Effective Habitat — Summer Living

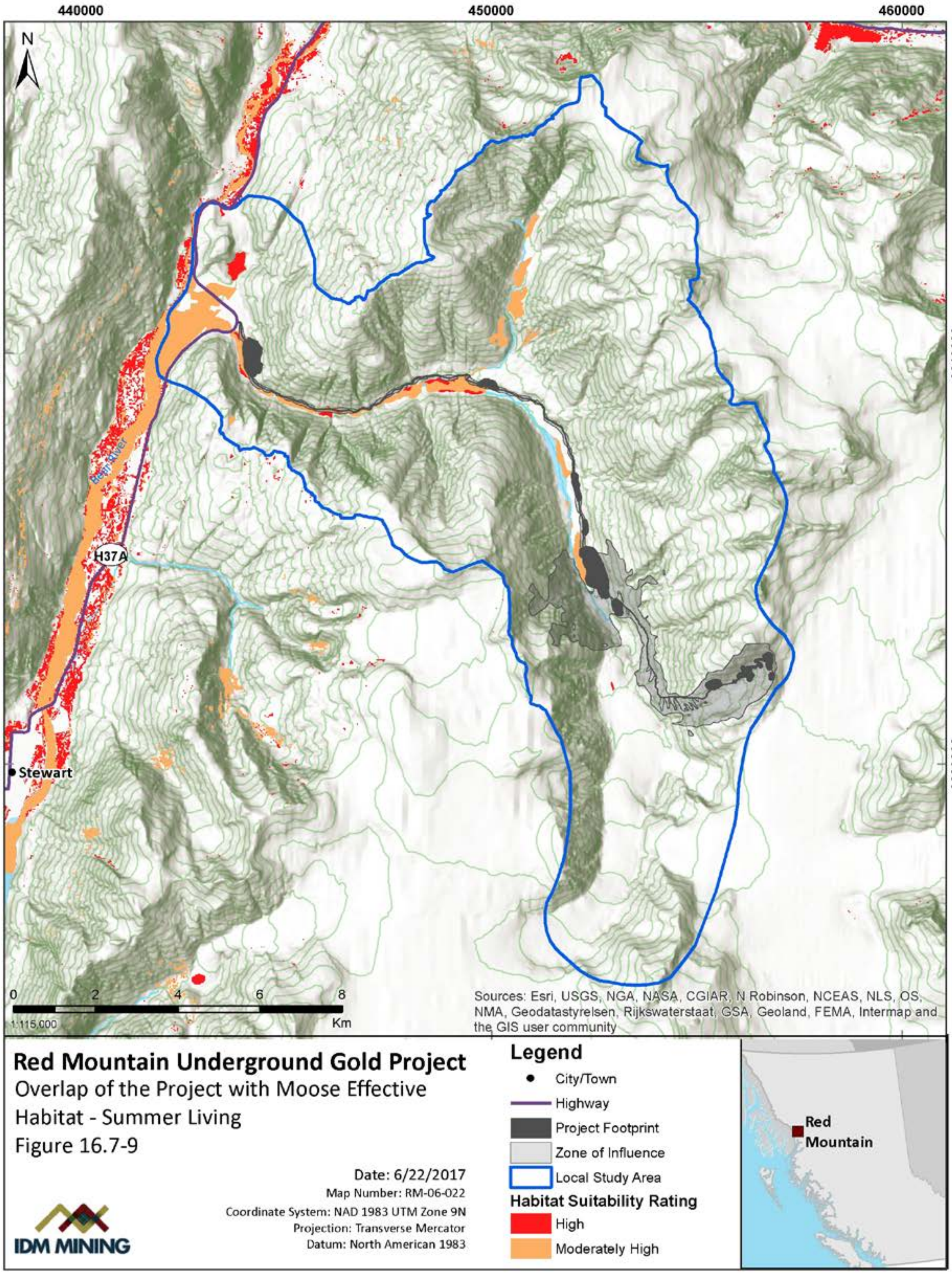
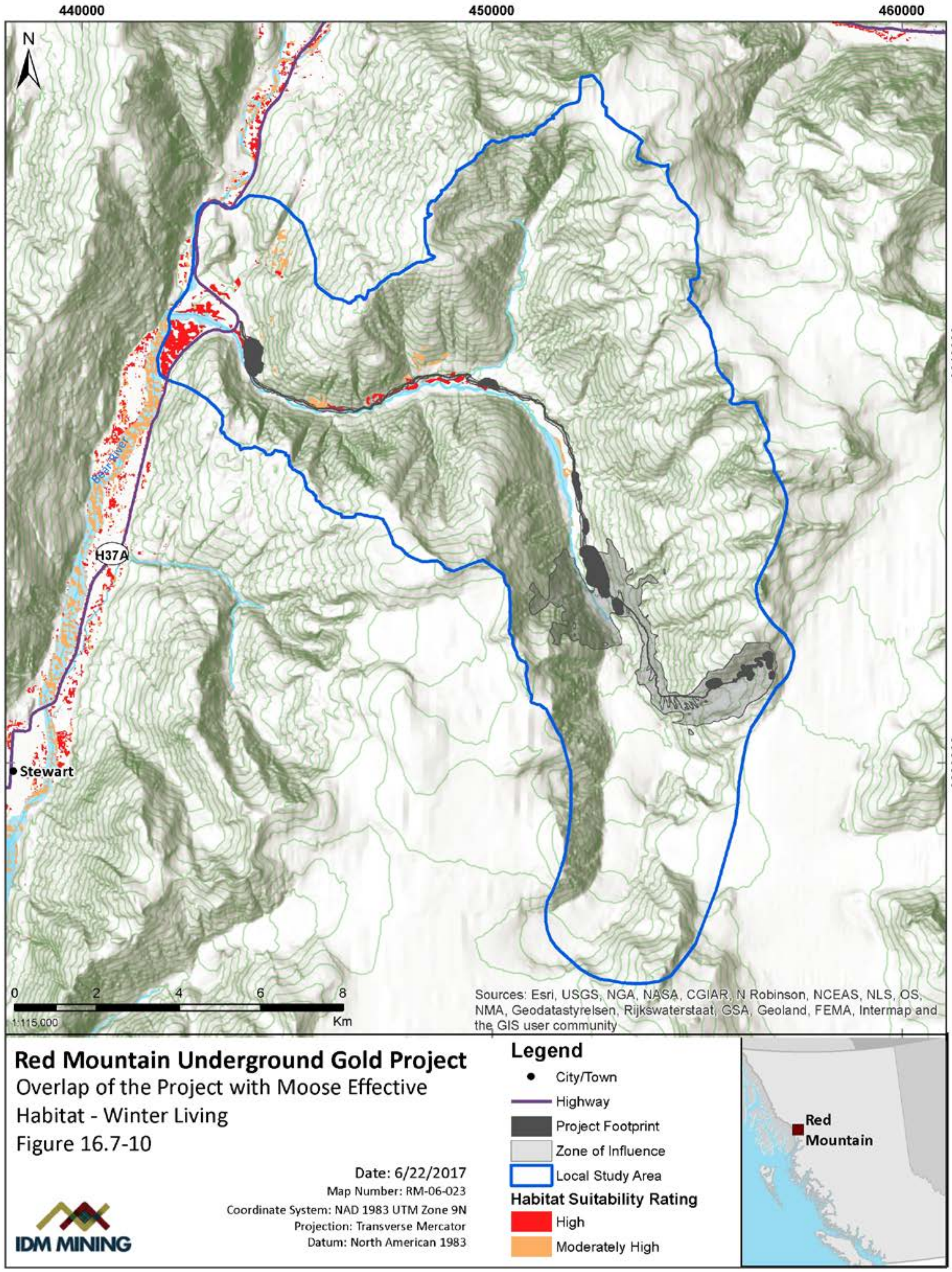


Figure 16.7-10: Overlap of the Project with Moose Effective Habitat — Winter Living



16.7.5.2 Mortality Risk

Even though no moose or signs of moose were observed during baseline surveys, there is the potential for an increase in mortality risk from an increased number of vehicles using the area and increase in length of access roads in Project area. Even if applicable mitigation measures are implemented there is still the possibility of a moose being hit by a vehicle. The apparent decreasing trend of the moose population contributes to the possibility of this increased risk leading to a residual effect.

16.7.5.2.1 Residual Effect Analysis

Roads in the RSA currently total approximately 76 km in length and there is currently 6 km of existing roads in the LSA. Roads are considered a concern to moose primarily due to increased human access, which can result in increased mortality due to vehicle collision. No absolute thresholds have been determined to define a road density that is acceptable to moose, but it can be assumed that the effect gets stronger as road density increases. Currently, the road density within LSA and the RSA is 0.04 km/km^2.

In general, across BC, collisions with moose peak in December and generally occur between 5:00 and 7:00 pm. In the North Coast region, approximately 148 moose were involved in vehicle collisions between 2006 and 2010 (O'Keefe and Rea 2012). Appendix 1-C states that based on available data, Project-related traffic is expected to have a maximum of a 3% increase in overall traffic rates, and the bulk of this traffic increase will be experienced during Project operations along Highway 37A between Stewart and the Project Access Road. This same study states that there could be a 1% increase in vehicle collisions (includes with other vehicles and wildlife).

16.7.5.2.2 Characterization of Residual Effect

It is expected that the probability of moose direct mortality due to vehicle collision in the LSA is very low based on the baseline survey results showing no observation of individual moose or signs of moose within areas surveyed in the LSA and based on the moose harvest data showing no moose harvested in MU 6-14 since 2011. It is still expected that the probability of moose direct mortality due to vehicle collision in the RSA is also low but having a higher probability of occurring than within the LSA since there will be a possible 3% increase in overall traffic rates during operations.

The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The effect of direct mortality is adverse due to the potential loss of individual moose. The significance determination was based on a moderate magnitude of the effect. Direct mortality will be long-term, will occur at sporadic intervals, will be discrete as it is limited to the Project footprint, and is reversible at the population level once the Project is closed and access is reclaimed or closed. Due to moose populations currently being in a decreasing trend (Gorley 2016), resilience to changes in mortality for the population is considered to be low.

16.7.5.2.3 Likelihood

Low, since no moose or signs of moose were recorded during baseline surveys.

16.7.5.2.4 Significance

Not Significant. The residual effect of direct mortality is considered not significant based on having a moderate magnitude, discrete in extent, and will sporadically occur. The effect of direct mortality on moose is distinguishable at the individual level.

16.7.5.2.5 Confidence and Risk

Moderate. There is a good understanding of moose life history requirements as they related to populations numbers. Currently there is not a full understanding in the number of moose potentially found within the RSA. There are unknown external variables with regards to why moose populations are declining within the RSA. There is a low risk that the Project effects could exceed those used in this assessment. This is supported by the point that no moose have been observed within the LSA.

16.7.6 Potential Residual Effects Assessment — Furbearers

Furbearers were assessed for potential Project-related effects of habitat availability (including habitat alteration and sensory disturbance), disruption to movement, direct and indirect mortality, chemical hazards, and attractants. Following the successful implementation of mitigation measures designed to reduce the risk of indirect mortality, chemical hazards, and attractants, these potential effects were determined to have no residual effects on furbearers and were not carried forward in the residual effects assessment. The remaining potential effects were carried forward in the residual effects assessment and detailed assessments are presented below.

16.7.6.1 Habitat Availability

The BC Wildlife Species Inventory database does not show any marten occurrences within the LSA; however, there are large numbers of observations within the eastern portion of the RSA along the White River, Nelson Creek, and Surprise Creek drainages.

Habitat availability includes changes to the amount of available habitat as a result of habitat alteration due to clearing and grubbing activities and habitat avoidance due to sensory disturbances. Habitat alteration and sensory disturbance was assessed quantitatively for marten or wolverine by calculating the amount of effective habitat (i.e., habitat rated as being high or moderate) overlapped with the Project footprint and ZOI, respectively.

16.7.6.1.1 Marten

Residual Effect Analysis

Approximately 14 ha of effective winter living habitat will be removed through clearing and grubbing activities and approximately 34 ha has the potential of being avoided due to sensory disturbances (Table 16.7-6; Figure 16.7-11). Effective winter living habitat will be reduced by less than 1% in the RSA.

Table 16.7-6: Summary of Change in Habitat Availability — Marten

Habitat Type	Area of Altered Habitat (ha)	Area of Sensory Disturbance (ha)	Total Habitat Change (ha)	LSA – Total Habitat (ha)	LSA – Habitat Change (%)	RSA – Total Habitat (ha)	RSA – Habitat Change (%)
Winter Living	14	34	49	1,157	4	21,175	<1

Characterization of Residual Effect

The Project is expected to have an adverse effect on marten habitat through habitat alteration and sensory disturbance. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. This effect will be low magnitude based on the calculated area of habitat change. The geographic extent of the effect is expected to be local. Habitat loss is expected to be long-term duration occurring from Construction Phase through the Closure and Reclamation Phase, occurring on a continuous basis, and reversible depending on successful reclamation and mine closure. Context is considered high.

Likelihood

High. Approximately 49 ha of effective winter living habitat will be changed as a result of Project activities.

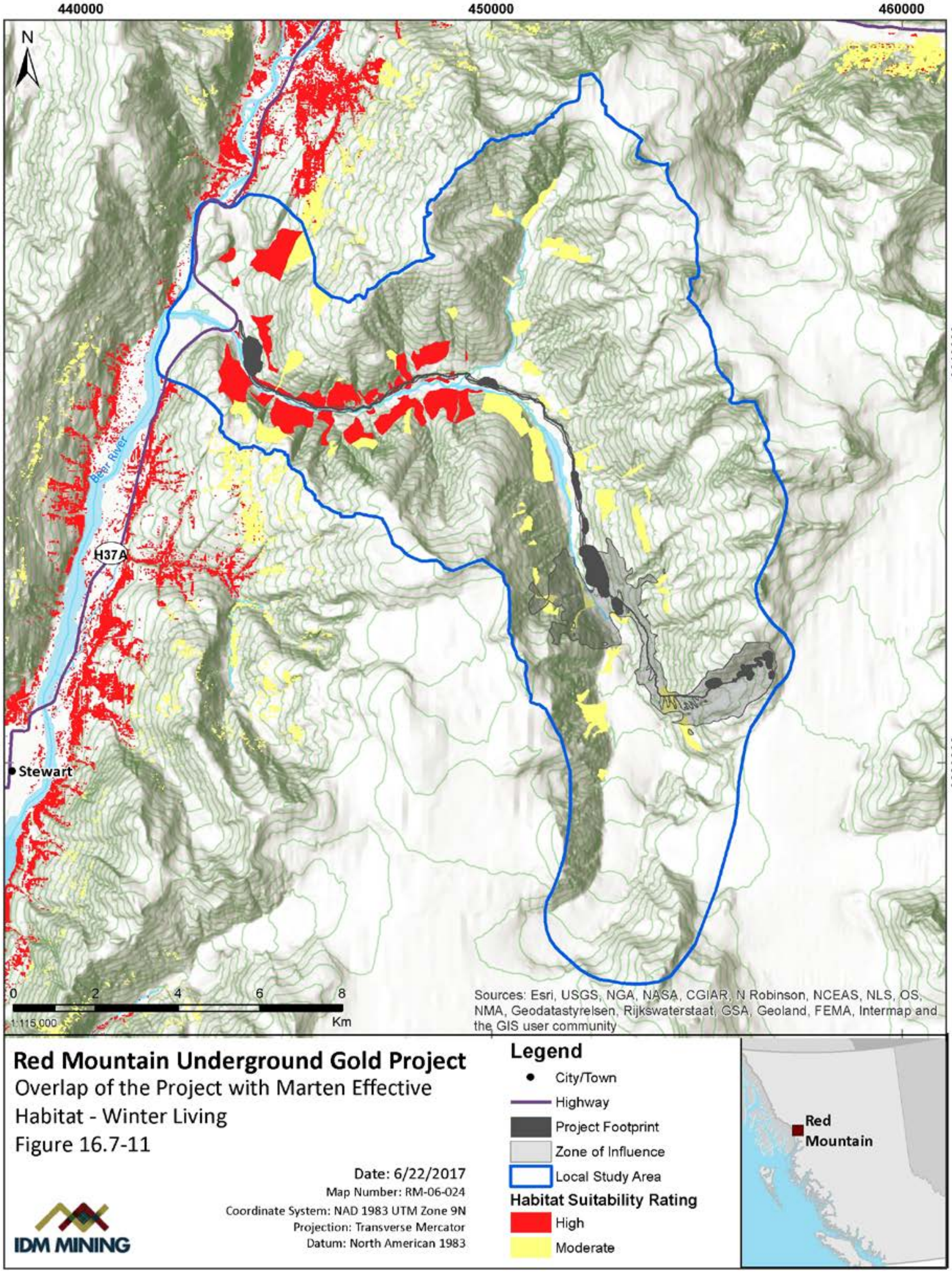
Significance

Not Significant. While discrete effects may occur, effects are not expected to pose risk to long-term persistence and viability of marten within the RSA. Studies have shown changes to marten home range location and size associated with forest development, especially in areas where greater than 25% of marten habitat was modified (Leiffers and Woodward 1997; Hargis et al. 1999; Chapin et al. 1999). In the Hargis and Bissonette (1997) study, it was demonstrated that marten may abandon an area, even high quality habitat areas or areas of low fragmentation, when habitat modifications exceeded 25%. The proposed Project footprint will not affect greater than 25% of high and moderate winter living habitat.

Confidence and Risk

High. There is a good understanding of required marten living habitat. There is a low degree of uncertainty associated with the baseline data and modeling results. Mitigation measures were considered to have some effectiveness in minimizing potential effects on habitat loss. There is very low risk that the Project effects could exceed those used in this assessment and more than likely, marten will continue to use some portions of the sensory disturbance ZOIs and the effects will be less than those used in this assessment.

Figure 16.7-11: Overlap of the Project with Marten Effective Habitat — Winter Living



16.7.6.1.2 Wolverine

Residual Effect Analysis

Wolverine growing living habitat suitability classes are almost evenly mapped across the LSA, with approximately half of the LSA mapped as high and moderate growing living habitat (Figure 16.7-12). The RSA contains approximately 59,311 ha and the LSA contains approximately 8,457 ha of effective wolverine growing living habitat (Table 16.7-7). The RSA and LSA contain 10,906 ha and 1,157 ha of effective winter denning habitat (Table 16.7-7; Figure 16.7-13). The amount of change to habitat availability in the RSA represents less than 1% of the effective growing season habitat and less than 1% of the winter season habitat.

Table 16.7-7: Summary of Change in Habitat Availability — Wolverine

Habitat Type	Area of Altered Habitat (ha)	Area of Sensory Disturbance (ha)	Total Habitat Change (ha)	LSA – Total Habitat (ha)	LSA – Habitat Change (%)	RSA – Total Habitat (ha)	RSA – Habitat Change (%)
Growing Living	120	344	465	8,457	5	59,311	<1
Winter Denning	14	34	49	1,157	4	10,906	<1

Banci (1994) stated that the cumulative effects on wolverine populations resulting from habitat alteration, forest harvesting, trapping, and access are not well understood. The major habitat threat is the large-scale conversion of mature and old forest structural stages into early structural stage habitats. Logging of high elevation forests may also affect rearing success (Lofroth and Weir 2004). Habitat alienation by wolverines usually results from human activities, especially increases in backcountry activities associated with extraction or exploration of natural resources or recreational activities such as snowmobiling.

Wolverine range and habitat are strongly related to the availability of prey species and they will be in the highest densities where their prey is abundant, although areas used by humans for recreation or resource extraction may be avoided (Krebs et al. 2007). The LSA does not contain an abundance of preferred prey species but hoary marmot and grouse species are found within the LSA.

Characterization of Residual Effect

The Project is expected to have an adverse effect on wolverine habitat through reduction in habitat availability. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. This effect was considered to have a low magnitude based on the habitat analysis. The level of this effect is expected to be approximately 1% of the available habitat in the RSA. The geographic extent of the effect is expected to be local. Habitat availability is expected to be long-term in duration occurring from Construction Phase through to the Closure and Reclamation Phase, occurring on a continuous basis, and reversible depending on successful reclamation. The context is high.

Likelihood

Moderate based on the fact it is known the footprint will reduce habitat availability but is moderated by the fact wolverine habitat modelling are largely based on where prey is available, which includes a wide range of habitat characteristics. Habitat modelling for wolverine is limited in its ability to predict the spatial location of the most effective habitat for the species.

Significance

Not Significant. The residual effect was determined to be not significant due to low magnitude, local extent, and reversibility.

Confidence and Risk

Moderate. There is a good understanding of required wolverine living habitat but some uncertainty associated with the amount of available prey species within the RSA. Mitigation measures were considered to have effectiveness in minimizing potential effects on habitat availability. There is very low risk that the Project effects could exceed those used in this assessment and more than likely, wolverine will continue to use some portions of the sensory disturbance ZOIs and the effects will be less than those used in this assessment.

Figure 16.7-12: Overlap of the Project with Wolverine Effective Habitat — Growing Living

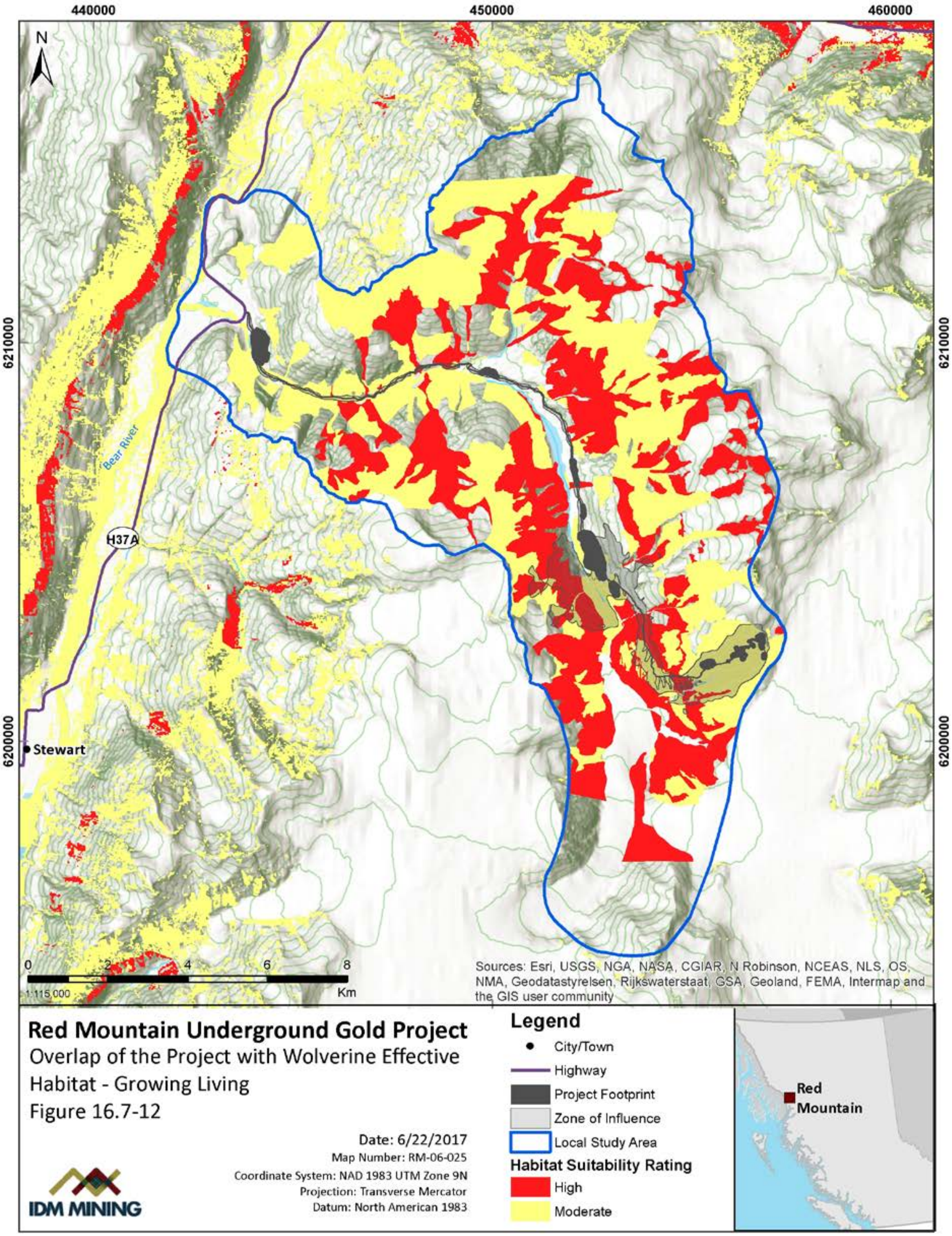
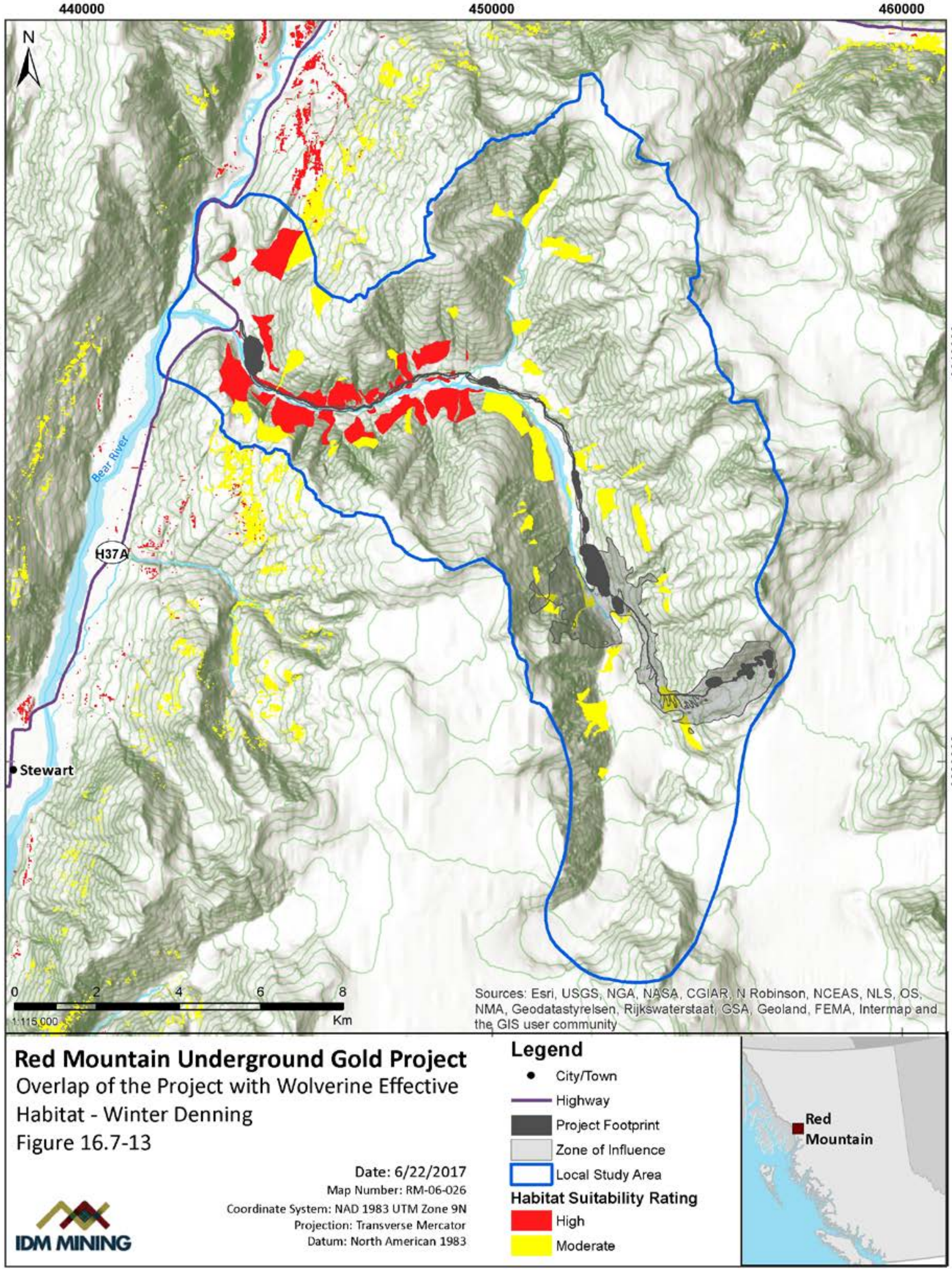


Figure 16.7-13: Overlap of the Project with Wolverine Effective Habitat — Winter Denning



16.7.6.2 Habitat Distribution

Early seral stage and large treeless tracts have the potential to act as barriers to marten movement (Gibilisco 1994; Hawley and Newby 1957). In BC, road densities greater than 2 km/km^2 are considered lower quality habitat for wolverine and road densities greater than 3 km/km^2 are considered not to support wolverines (Lofroth and Krebs 2007). Currently, the road density within LSA and the RSA is 0.04 km/km^2, and it is assumed that road density will not affect wolverine movement.

Large highways and roads can act as movement barriers for wolverines (COSEWIC 2014). Traffic levels between 300 and 500 vehicles per day have been suggested as a threshold for highways acting as a barrier to carnivore movements based on a multi-species study in the Canadian Rocky Mountains (Alexander et al. 2005). On the Trans-Canada Highway, wolverines selected sections with narrower rights-of-way (mean 68 m) to cross instead of wider rights-of-way (mean 165 m; Austin 1998). Traffic levels within the LSA will not reach the thresholds values and were considered not to affect wolverine movement through the LSA or RSA.

16.7.6.2.1 Marten

Residual Effect Analysis

Snow tracking surveys comparing marten response to roads indicated that marten were as likely to be found near roads as away from roads, but tracks were more clumped away from roads suggesting that movement patterns and habitat use differed near roads (Robitaille and Aubry 2000). This could suggest that marten avoid areas that are more open (lack overhead cover), such as roads and forest edges. Bissonette and Sherburne (1993) demonstrated that marten typically do not readily cross open areas wider than 100 m.

High-quality marten habitat exists on both sides of the proposed Access Road starting from the turn-off at Highway 37A to Bromley Humps and the Process Plant. This Access Road runs adjacent to Bitter Creek, which does provide a natural barrier to marten movement within these large patches of high quality marten winter habitat. Marten may travel across Bitter Creek in areas where natural bridges, such as fallen trees, cross the creek. Literature does state that marten will not readily cross open areas wider than 100 m and the road ROW will be below this threshold.

No high or moderate winter living habitat will be fragmented by Project buildings or tailings pond or waste rock piles.

Characterization of Residual Effect

The Project is expected to have an adverse effect on marten movement. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The effect of disruption to marten movement was considered to have a low magnitude based on qualitative assessment of the amount of new disturbance overlapping suitable habitat relative to habitat available. The geographic extent of the effect is expected to be local and is expected to be of long-term duration occurring from Construction Phase through the

Closure and Reclamation Phase. This effect has a continuous frequency and is reversible once reclamation is successfully completed. Context is considered high.

Likelihood

Low since the road ROW is below the threshold limit of 100 m and portions of high quality winter habitat is currently naturally fragmented by Bitter Creek.

Significance

Not Significant. The Project will be constructed with minimal clearing disturbance and the Access Road is less than the 100 m crossing threshold. Marten have been known to use drainage culverts to access habitats on either side of roads (Clevenger et al. 2001).

Confidence and Risk

High. Existing studies provide good information on how linear features could potentially affect marten movement patterns. There is a moderate degree of uncertainty associated with the baseline data and modeling results. Mitigation measures were considered to have a moderate effectiveness in minimizing potential effects on sensory disturbance. There is very low risk that the Project effects could exceed those used in this assessment.

16.7.6.3 Mortality Risk

Direct mortality of marten has the potential to occur as a result of vegetation clearing and vehicle collisions along Project roads. Mortality is not predicted to be a residual effect for wolverine, which did not have any records of mortality due to vehicle collisions (Sielecki 2004, 2010).

16.7.6.3.1 Marten

Residual Effect Analysis

Direct mortality to marten from vehicle collisions is expected be infrequent since marten are known to avoid areas that lack overhead cover and roads (Poole et al. 2004). This statement is supported by mortality records of marten along highways. The Bulkley-Stikine District mortality records database lists three vehicle-marten collisions occurring between 1983 and 2007 (Sielecki 2004, 2010) and in Banff National Park, marten were part of the 2% small vertebrate road kills (Clevenger et al. 2003).

If Project-related vegetation clearing occurs during marten birthing and rearing periods then incidental mortality of females and their young could occur. Typically maternal dens can be found within large spruce trees or cottonwoods or hollow logs. In general, young are born in late March and then mothers may move young to a second maternal den site (Powell et al. 2003). The young are often able to leave the den site in late spring (Ruggiero et al. 1994).

Characterization of Residual Effect

The Project is expected to have an adverse effect on marten direct mortality. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The effect was considered to have a low magnitude considering the low traffic volume and small amount of new disturbance interacting with a small area of suitable marten habitat relative to that available in the RSA. The geographic extent of the effect is expected to be discrete and is expected to be long-term in duration occurring from Construction Phase to Closure and Reclamation Phase. This effect has a sporadic frequency, and is considered reversible once the Project is closed and access is reclaimed or closed. Context is considered neutral.

Likelihood

Low since vehicle collision with marten and the destruction of an active maternal den has a low probability of occurring.

Significance

Not Significant. With the implementation of mitigation measures, Project-related direct mortality is unlikely to contribute to population level effects on marten.

Confidence and Risk

High. Even though mitigation measures were considered to have a moderate effectiveness in minimizing potential effects direct marten mortality the probability of marten being killed due to vehicle collision or vegetation clearing is considered very low. There is a very low risk that the Project effects could exceed those used in this assessment.

16.7.7 Potential Residual Effects Assessment — Hoary Marmot

Hoary marmots were assessed for potential Project related effects of habitat availability and direct mortality since these effects are likely to create residual effects on hoary marmot populations. Following implementation of effective mitigation measures in conjunction with habitat preferences, disruption of movement, indirect mortality, attractants, and chemical hazards were not considered residual effects and were not carried forward into the effects assessment.

Disruption of movement was not considered a residual effect for hoary marmots because of their small home ranges (less than 14 ha) (Armitage 2000) and Project components within hoary marmot habitat are not expected to block or alter existing movement patterns. Colonies within the Project footprint and 300 m buffer have been assessed under habitat loss and direct mortality (Sections 16.7.7.1 and 16.7.7.2).

Indirect mortality as a result of increased hunting pressure and increased predation within Project infrastructure is not expected to occur. High elevation areas within the Project footprint and LSA will have restricted access and IDM is committed to developing and enforcing a policy prohibiting hunting. Hoary marmots inhabit talus slopes and naturally open areas; therefore, vegetation changes are unlikely to result in increased predation. Sediment ponds and other Project components may pose entrapment hazards for hoary marmots; however, wildlife exclusion measures are expected to effectively mitigate these effects.

Attractants and chemical hazards may be present at the active Mine Site; however, marmots are unlikely to be attracted to these as they prefer herbaceous forage. In addition, IDM will implement mitigation measures, such as appropriate storage and handling of potential attractants and chemical hazards along with the development and implementation of the Wildlife Education Program and wildlife protection protocols, to avoid or minimize these effects.

The spatial boundary for the effects assessment of hoary marmot was selected as the LSA rather than the RSA due to their small home range sizes relative to other Wildlife VC species. Hoary marmot have a small home range of 14 ha and limited dispersal distances. Therefore, the LSA area of 15,877 ha is more biologically relevant for assessing context of effects to this species than the RSA area of 205,350 ha.

16.7.7.1 Habitat Availability

Habitat availability includes changes to the amount or quality of available habitat as a result of direct habitat alteration. This was assessed quantitatively for hoary marmots within the context of the LSA by calculating how much effective habitat (i.e., habitat rated as moderate or high suitability) overlapped with the Project footprint.

16.7.7.1.1 Residual Effect Analysis

The LSA contains 684 ha of high and moderate summer living habitat for hoary marmot (Figure 16.7-14). These habitats occur in high elevation areas (more than 1,200 m) with south-facing slopes, which are primarily along the eastern boundary of the LSA. The majority of Project components will not affect hoary marmot habitat since these facilities are generally located in valley bottoms and not within alpine marmot habitat. Project components related to the Mine Site and Haul Road within alpine habitat may have an effect on hoary marmot habitat.

Alteration of effective hoary marmot habitat (high or moderate suitability ratings) as a result of the Project footprint is expected to comprise 5% of the effective habitat within the LSA. No high-quality marmot habitat overlaps with the Project footprint (Table 16.7-8).

Denning (winter living) habitat is considered comparable to summer living habitat because habitat requirements for the two life stages are indistinguishable.

During baseline studies, hoary marmots and sign were observed in talus slopes and alpine heather meadows, corresponding with moderate to high habitat ratings. Individuals and burrows were observed in the Goldslide Creek basin above the existing exploration camp. Additional colonies were observed in LSA. A large colony with multiple den entrances was located in the Rio Blanco Creek basin north of Goldslide Creek (Appendix 16-A).

Habitat alteration is predicted to result in a residual effect on hoary marmots within the LSA. This is considered a residual effect because dens and colonies may be affected after mitigation measures are applied, particularly along the mine Haul Road. Dens are used for multiple purposes and are a necessary habitat feature for breeding, rearing of young, and winter. Dens also provide escape mechanisms to evade predation.

Table 16.7-8: Summary of Change in Habitat Availability — Hoary Marmot

Habitat Type	Area of Altered Habitat (ha)	Area of Sensory Disturbance (ha)	Total Habitat Change (ha)	LSA – Total Habitat (ha)	LSA – Habitat Change (%)
Summer Living	31	0	31	684	5

16.7.7.1.2 Characterization of Residual Effect

The Project is expected to have an adverse effect on hoary marmot habitat through direct habitat alteration. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. This effect was considered to have a low magnitude based on the habitat analysis. Although these effects are not expected to result in changes from baseline conditions, a conservative approach was used in determining magnitude of the effect since baseline data represents incidental observations. The geographic extent of the effect is expected to be discrete and entirely within the Goldslide Creek basin. Hoary marmots have small home ranges (<14 ha) and typically forage within 200 to 300 m of their burrows (RIC 1998d). Habitat loss and alteration is expected to be long-term duration occurring from Construction Phase through the Closure and Reclamation Phase, continuous in frequency, and reversible. Context is considered neutral.

16.7.7.1.3 Likelihood

High. Although the assessment baseline conditions is based on incidental observations and additional denning sites may be present within the Project footprint, effective mitigation measures, such as minimizing habitat disturbance through establishment of no-disturbance buffers surrounding sensitive habitat features (i.e., den sites), will be implemented. However, vegetation clearing for the Project footprint is likely to affect foraging sites.

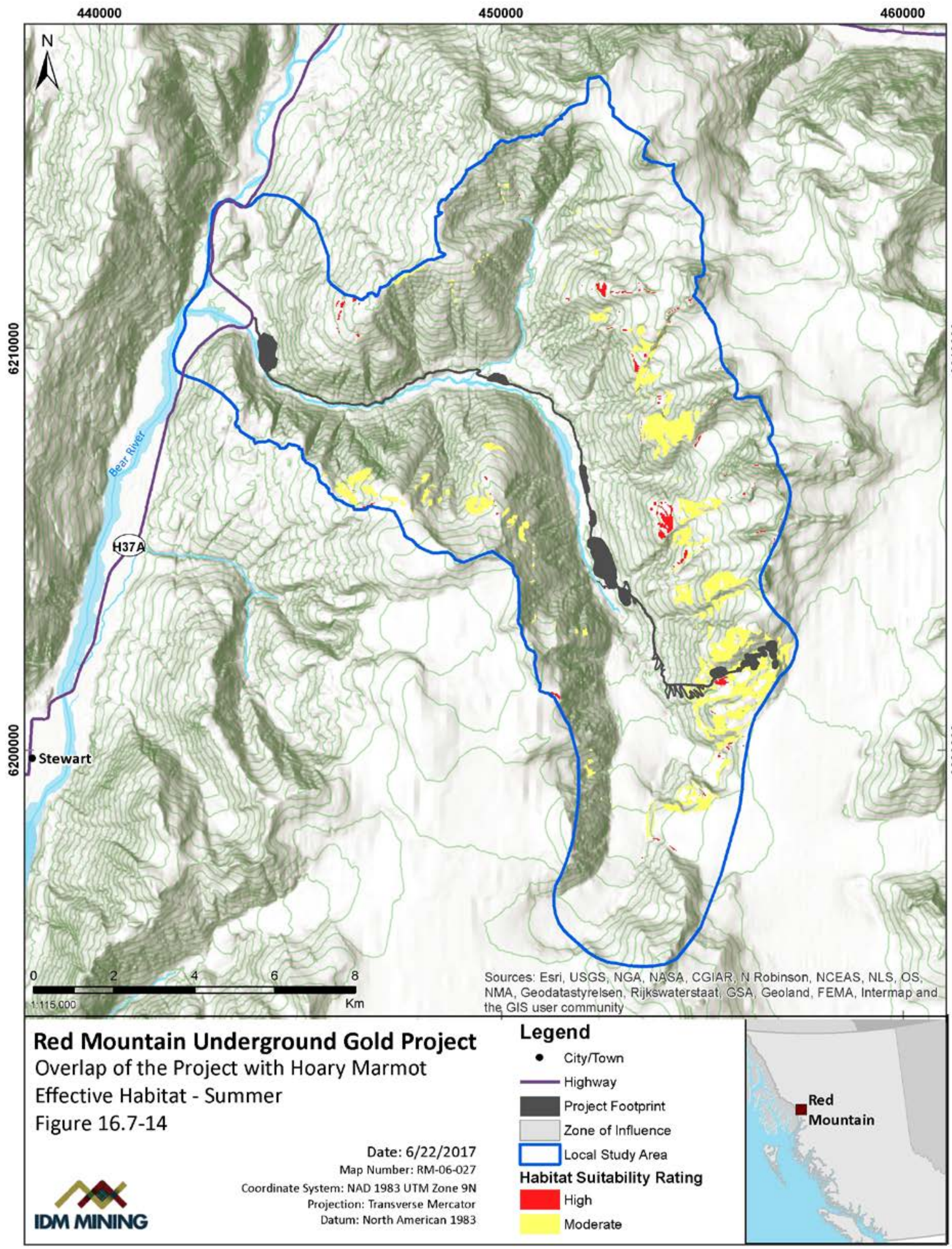
16.7.7.1.4 Significance

Not Significant. Project effects on habitat availability are considered not significant because any residual effect will have a low magnitude, a discrete extent, and be reversible. Based on these criteria it is unlikely that the Project will have a measurable effect on the size or viability of the hoary marmot population within the LSA.

16.7.7.1.5 Confidence and Risk

Moderate. A conservative approach was taken during the assessment. Modeled WHRs correlated well with observations of hoary marmot individuals and sign. In addition, mitigation measures were considered moderately effective in minimizing potential effects on habitat loss or alteration.

Figure 16.7-14: Overlap of the Project with Hoary Marmot Effective Habitat — Summer Living



16.7.7.2 Mortality Risk

16.7.7.2.1 Residual Effect Analysis

Direct mortality on hoary marmot within the LSA was evaluated as a potential residual effect. During baseline studies hoary marmots and sign were observed in talus slopes and alpine heather meadows, corresponding with moderate to high habitat ratings. Individuals and burrows were observed in the Goldslide Creek basin above the existing exploration camp and adjacent to the mine Haul Road. Direct mortality could occur as a result of dens being located within the Project footprint during Construction Phase. Vehicle collisions along the Access Road to and within the Mine Site may also result in direct morality.

16.7.7.2.2 Characterization of Residual Effect

The effect of direct morality is expected to be a residual effect since hoary marmots could suffer direct morality if their dens are within the Project footprint. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. This effect was considered to have a moderate magnitude since dens are located immediately adjacent to the proposed Haul Road; however, this is not a unique or isolated area of suitable habitat in the context of the population. The geographic extent of the effect is expected to be discrete and entirely within the Goldslide Creek basin. Hoary marmots have small home ranges (less than 14 ha) and typically forage within 200 to 300 m of their burrows (RIC 1998d). Effects of direct morality are expected to be long-term duration occurring from Construction Phase through the Closure and Reclamation Phase, with a sporadic frequency, and reversible. Context is considered neutral.

16.7.7.2.3 Likelihood

Moderate. While baseline conditions represent incidental observations and additional denning sites may be present within the Project footprint, effective mitigation measures, such as minimizing habitat disturbance through establishment of no-disturbance buffers surrounding sensitive habitat features (i.e., den sites), will be implemented. Mitigation measures will also address vehicle traffic; for example, minimizing Project traffic and reducing speed limits.

16.7.7.2.4 Significance

Not Significant. Project effects on habitat availability are considered not significant because any residual effect will be sporadic in frequency, have a moderate magnitude, a discrete extent, and be reversible. Based on these criteria it is unlikely that the Project will have a measurable effect on the size or viability of the hoary marmot population within the LSA.

16.7.7.2.5 Confidence and Risk

Moderate. A precautionary approach was taken during the assessment. The habitat preferences of hoary marmot are well-known. Baseline information included a habitat model and field surveys. In addition, mitigation measures are established, have been used before and were considered effective in minimizing potential effects on direct mortality.

16.7.8 Potential Residual Effects Assessment — Bats

Bats were assessed for potential Project-related effects of habitat alteration, sensory disturbance, direct mortality, chemical hazards, and attractants. Potential Project-related effects habitat disruption and indirect mortality were determined to have no direct interaction on bats (see Section 16.5.2). Following the successful implementation of mitigation measures designed to reduce the risk of direct mortality, chemical hazards, and attractants, these potential effects were determined to have no residual effects on bats and were not carried forward in the residual effects assessment. Rationale is provided below. The potential effect on habitat availability (including habitat alteration and sensory disturbance) was carried forward in the residual effects assessment and detailed assessments are provided in this section.

Direct mortality and attractants are expected to be fully mitigated through the identification and buffering of bat habitat features, such as hibernaculum and maternity roosts, and insect-friendly lighting manufactured to not attract insects and therefore not attract bats. Direct mortality related to collisions with vehicles at dawn and disk is a possibility and will be reduced by standard vehicle mitigation (e.g., traffic limitations and speed reduction) and limited traffic during crepuscular hours.

16.7.8.1 Habitat Availability

Bats in the LSA can roost in both caves/crevices and trees during feeding, foraging, and rearing. Usually these sites are near water sources (e.g., ponds, wetlands, seeps, lakes). Caves, cliffs, rock outcrops, and abandoned mineral exploration sites are also important habitat features since they can support populations in during roosting and hibernation. Typically alterations to bat habitat are the greatest during the construction phase of development projects, especially where project components are being built, vegetated areas are being cleared, and land is being excavated. There were no hibernacula locations documented to date; however, there is likely potential for bat hibernacula in the LSA.

Habitat availability includes changes to the amount of available habitat as a result of habitat alteration and sensory disturbance. Habitat availability was quantitatively assessed as the amount of habitat considered effective for bats. A two-category rating scheme was used to map growing living habitat, which is considered favourable for foraging, daytime roosting, and maternal roosting.

Potential sensory disturbance would be associated with lights at night at the mine facilities and noise related to ongoing operations both day and night. Lights have the risk of attracting high abundance of insects and thus bats, while noise may affect foraging in the area at night it may also affect daytime roosting. In either case, it is anticipated these effects would be partly mitigated by standard mitigation measures: noise restrictions, properly maintained equipment, standard noise dampening measures, and the use of directed/focused lighting rather than broad area lighting.

The remaining sensory disturbance effect was primarily attributed to noise and is predicted to be contained within the modelled noise boundary used as the ZOI. The area of sensory disturbance was estimated by assuming the favourable bat habitat in the ZOI surrounding the Project footprint would be downgraded to not favourable. This assessment incorporates the potential for change in habitat use by bats related to linear corridors. Construction of the road and/or Powerline has the potential to alter the way bats use suitable habitat through avoidance of linear features (Altringham and Kerth 2016). Complete loss of the suitable habitat in the ZOI due to sensory disturbance is considered a precautionary approach that likely overestimates the change in habitat use surrounding the Project.

16.7.8.1.1 Residual Effect Analysis

The LSA contains approximately 2,893 ha of effective bat living habitat (Table 16.7-9; Figure 16.7-15). Approximately 9% (248 ha) of the effective habitat mapped in the LSA is considered habitat no longer available due to the habitat being altered by Project clearing activities and sensory disturbance.

Table 16.7-9: Summary of Change in Habitat Availability — Bats

Habitat Type	Area of Altered Habitat (ha)	Area of Sensory Disturbance (ha)	Total Habitat Change (ha)	LSA – Total Habitat (ha)	LSA – Habitat Change (%)
Growing Living	48	199	248	2,893	9

16.7.8.1.2 Characterization of Residual Effect

The Project is expected to have an adverse effect on bat habitat through direct habitat alteration and sensory disturbance. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. This effect was considered to have a moderate magnitude based on the habitat analysis (9% habitat change). Loss of 248 ha of habitat is not likely to affect local populations. The carrying capacity of the landscape for bats is therefore unlikely to be affected by habitat loss given the large amount of habitat potentially available in the study area. The geographic extent of the effect is expected to be discrete and entirely within the Project footprint. Habitat alteration is expected to be long-term in duration and continuous occurring from Construction Phase to the Closure and Reclamation Phase as bats generally prefer older trees for roosts. The effect is reversible once the Project is decommissioned and the habitat is reclaimed and allowed to develop to maturity. Context is considered high as bats tend to use multiple tree roosts in a season and it is likely that bats will locate alternate tree roosts after clearing given there is quality habitat within the LSA.

16.7.8.1.3 Likelihood

Moderate. Reduction of habitat availability is due to direct habitat alteration is certain to result in a reduction of the preferred roosting habitat for bats in the Project footprint, whereas reduction of habitat availability due to sensory disturbance is not likely to occur at the level estimated in this assessment.

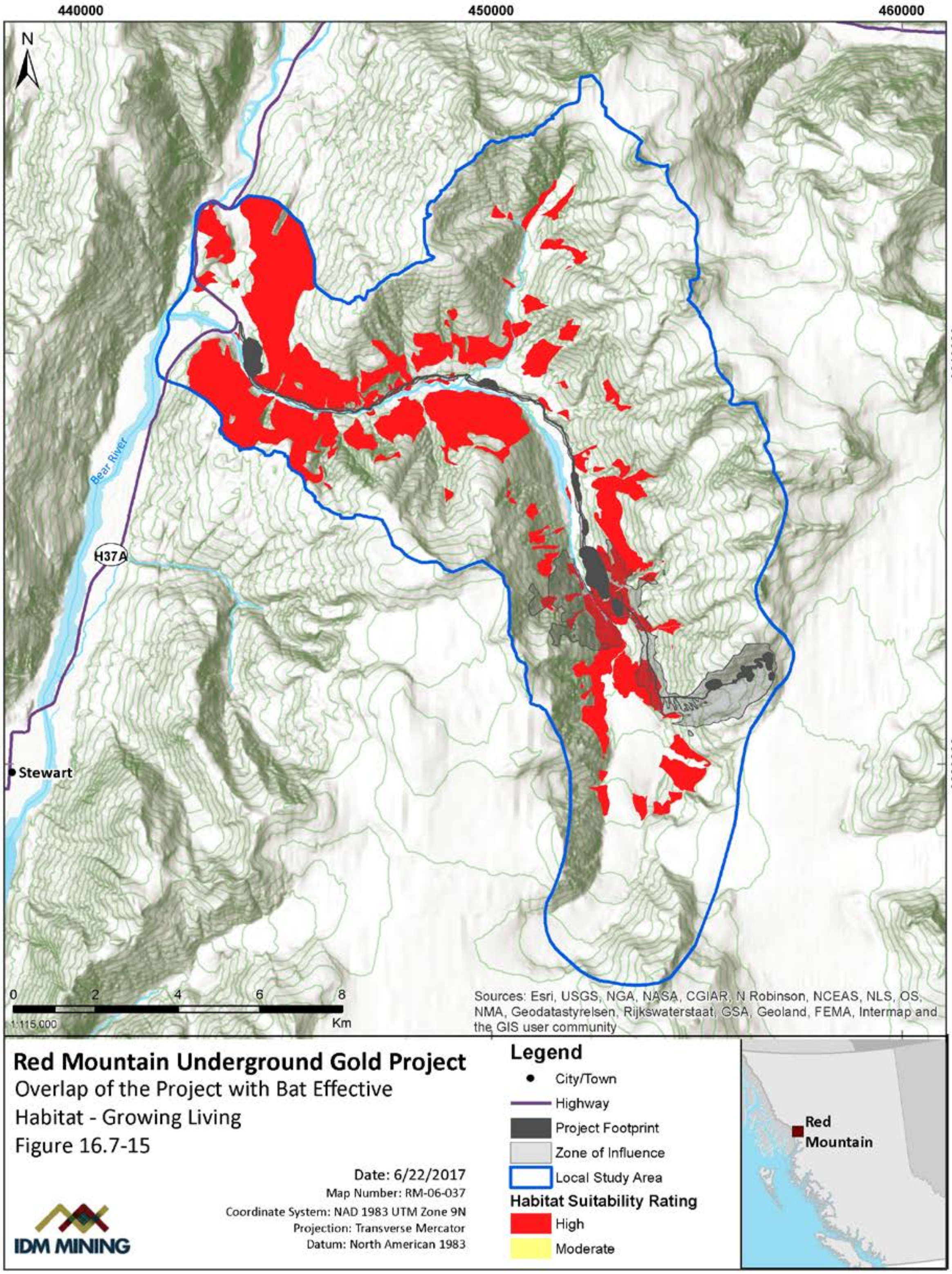
16.7.8.1.4 Significance

Not Significant. The residual effect of habitat alteration is considered not significant based on having a moderate magnitude for suitable growing season living habitat, being discrete in extent, long-term in duration, and reversible. Given the availability of favorable (useable) habitat within the LSA, bats should be able to exploit alternate roosts located outside of the relatively small footprint area.

16.7.8.1.5 Confidence and Risk

Moderate. There is good understanding of bat life history requirements for the species that may be present; however, there is limited information as to their use of this area and there is a moderate degree of uncertainty associated with modelling techniques and area abundance.

Figure 16.7-15: Overlap of the Project with Bat Effective Habitat — Growing Living



16.7.9 Potential Residual Effects Assessment — Migratory Breeding Birds

A habitat guild approach was used for all migratory breeding birds with the exception of species covered by species-specific habitat suitability mapping, including MacGillivray's warbler (Section 16.7.9.2) and species at risk (Section 16.7.10). Habitat guilds were used to group species of migratory birds based on known nesting habitat associations including alpine, riparian, old/mature forest, and shrub/early successional (Appendix 16-A).

Potential residual effects to migratory breeding birds include habitat availability (including habitat alteration and sensory disturbance) and mortality risk through direct mortality, indirect mortality, chemical hazards, and attractants. The potential effects of the Project on migratory breeding birds are addressed by a combination of mitigation measures as described in Section 16.6 and the WMP (Volume 5, Chapter 29). Mitigation measures that will minimize potential effects include Project design measures, minimizing habitat disturbance, avoiding disturbance during the breeding season, conducting pre-clearing nest surveys during the breeding season if disturbance cannot be avoided, managing vehicle traffic (e.g., speed limits), preventing wildlife entrapment in Project infrastructure, and managing chemical hazards and attractants.

Following the successful implementation of the mitigation measures described in Section 16.6 and the WMP, mortality risk was not considered a residual effect for migratory breeding birds and was not carried forward into the effects assessment. Mortality risk is expected to be fully mitigated through the identification and buffering of active bird nests and habitat features. Direct mortality related to collisions with vehicles and the Powerline is a possibility and will be reduced by standard vehicle mitigation (e.g. traffic limitations and speed reduction), Project design, and best practices related to transmission lines (see WMP Volume 5, Chapter 29). The residual effects that are anticipated to remain with respect to migratory breeding birds are habitat alteration and sensory disturbance.

16.7.9.1 Migratory Breeding Birds Habitat Guilds

16.7.9.1.1 Habitat Availability

Habitat availability includes changes to the amount or quality of effective nesting habitat by habitat guild (i.e., habitat rated as suitable) as a result of habitat alteration or sensory disturbance. Habitat alteration was assessed quantitatively for migratory breeding bird species within the RSA by calculating the amount of effective nesting habitat that overlapped with the Project footprint. Sensory disturbance was assessed quantitatively within the RSA by calculating the amount of effective nesting habitat that overlapped within the ZOI. The ZOI for migratory breeding birds included 150 m around the Project footprint. The habitat ratings within the ZOI were downgraded by one habitat class. Habitat guilds used a 2-class habitat model, therefore all habitat within the ZOI changed from suitable to unsuitable. MacGillivray's warbler used a 4-class habitat model; therefore high rated habitat became moderate habitat and moderate rated habitat became low habitat. The resulting habitat values were then summarized and compared to the baseline values.

Residual Effect Analysis – Habitat Guilds

The LSA contains 6,204 ha, 3,301 ha, 2,797 ha, and 1,446 of effective habitat (i.e., habitat rated as suitable) for migratory breeding birds in the alpine, old/mature forest, riparian, and shrub/early successional habitat guilds, respectively (Table 16.7-10; Figure 16.7-16; Figure 16.7-17; Figure 16.7-18; Figure 16.7-19). These habitats occur throughout the LSA at all elevations and in many cases adjacent to Project infrastructure.

The habitat assessment indicated that approximately 155 ha, 312 ha, 394 ha, and 184 ha of effective habitat may be lost or altered due to the combined Project footprint and area of sensory disturbance within the alpine, old/mature forest, riparian, and shrub/early successional habitat guilds, respectively (Table 16.7-10). This represents a loss of less than 1% of effective habitat within the RSA for alpine, old/mature forest, and riparian habitat guilds. Within the shrub/early successional habitat guild this represents a 2% loss of effective habitat within the RSA.

Table 16.7-10: Summary of Change in Habitat Availability — Bird Guilds

Habitat Type	Area of Altered Habitat (ha)	Area of Sensory Disturbance (ha)	Total Habitat Change (ha)	LSA – Total Habitat (ha)	LSA – Habitat Change (%)	RSA – Total Habitat (ha)	RSA– Habitat Change (%)
Alpine	45	109	155	6,204	2	34,653	<1
Old/Mature Forest	71	241	312	3,301	9	34,249	<1
Riparian	110	284	394	2,797	14	49,889	<1
Shrub/Early Successional	49	134	184	1,446	13	12,146	2

Characterization of Residual Effect

The Project is expected to have an adverse effect on the effective nesting habitat of migratory breeding birds related to habitat alteration and sensory disturbance. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The combined effects are considered to have a low magnitude at the RSA level, as approximately 4% of the effective RSA nesting habitat will be directly or indirectly affected by Project activities. The geographic extent of the combined effects is expected to be local. Habitat alteration and sensory disturbance are expected to be long-term in duration with effects occurring from the Construction Phase to the Closure and Reclamation Phase. The effects of habitat alteration and sensory disturbance will be continuous throughout the Project but are considered reversible once mining activities cease and reclamation occurs. Context is considered high because in general the assessed migratory bird species have high natural resilience to imposed stresses and can respond and adapt to the effect, especially given the amount of available habitat within the RSA.

Likelihood

High. Effective nesting habitat will overlap with the Project footprint and also be subject to sensory disturbance from Project activities.

Significance

Not Significant. The combined residual effects of habitat alteration and sensory disturbance are assessed to be not significant at the RSA level for migratory breeding birds based on a low magnitude, a long-term duration, and a regular occurrence. These species are also considered to have high resilience to changes in habitat availability. Habitat alteration and sensory disturbance will result in a greater than negligible adverse effect but the effect is considered reversible and it is unlikely that these effects would pose a risk to the long-term persistence and viability of migratory breeding birds at the regional level (i.e., RSA).

Confidence and Risk

Moderate. The primary uncertainty associated with this prediction is the degree to which migratory breeding birds are actually displaced by mining operations within the sensory disturbance zones, resulting in reduced habitat. Further uncertainty is related to how well the habitat guilds reflect actual habitat use by migratory breeding birds within the RSA. The assumptions used in this assessment are precautionary, both in terms of the sizes of the disturbance ZOIs and magnitude of effect (i.e., complete loss of habitat), and likely overestimate potential Project effects on habitat availability. There is very low risk that the Project effects could exceed those used in this assessment. More likely, migratory breeding birds will continue to use some portions of the sensory disturbance ZOIs and the effects will be less than those used in this assessment.

Figure 16.7-16: Overlap of the Project with Migratory Breeding Bird Effective Habitat — Alpine

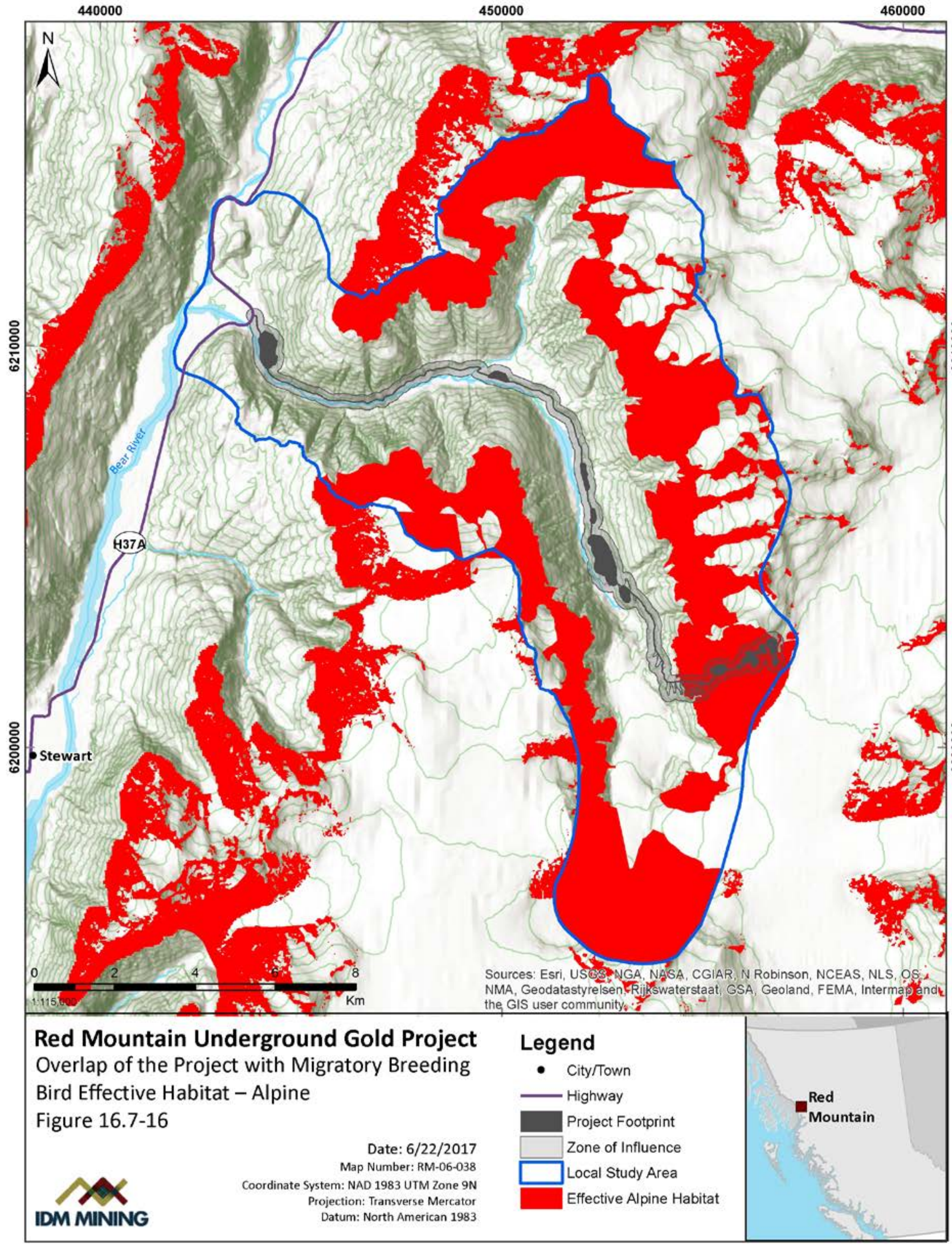


Figure 16.7-17: Overlap of the Project with Migratory Breeding Bird Effective Habitat — Old/Mature Forest

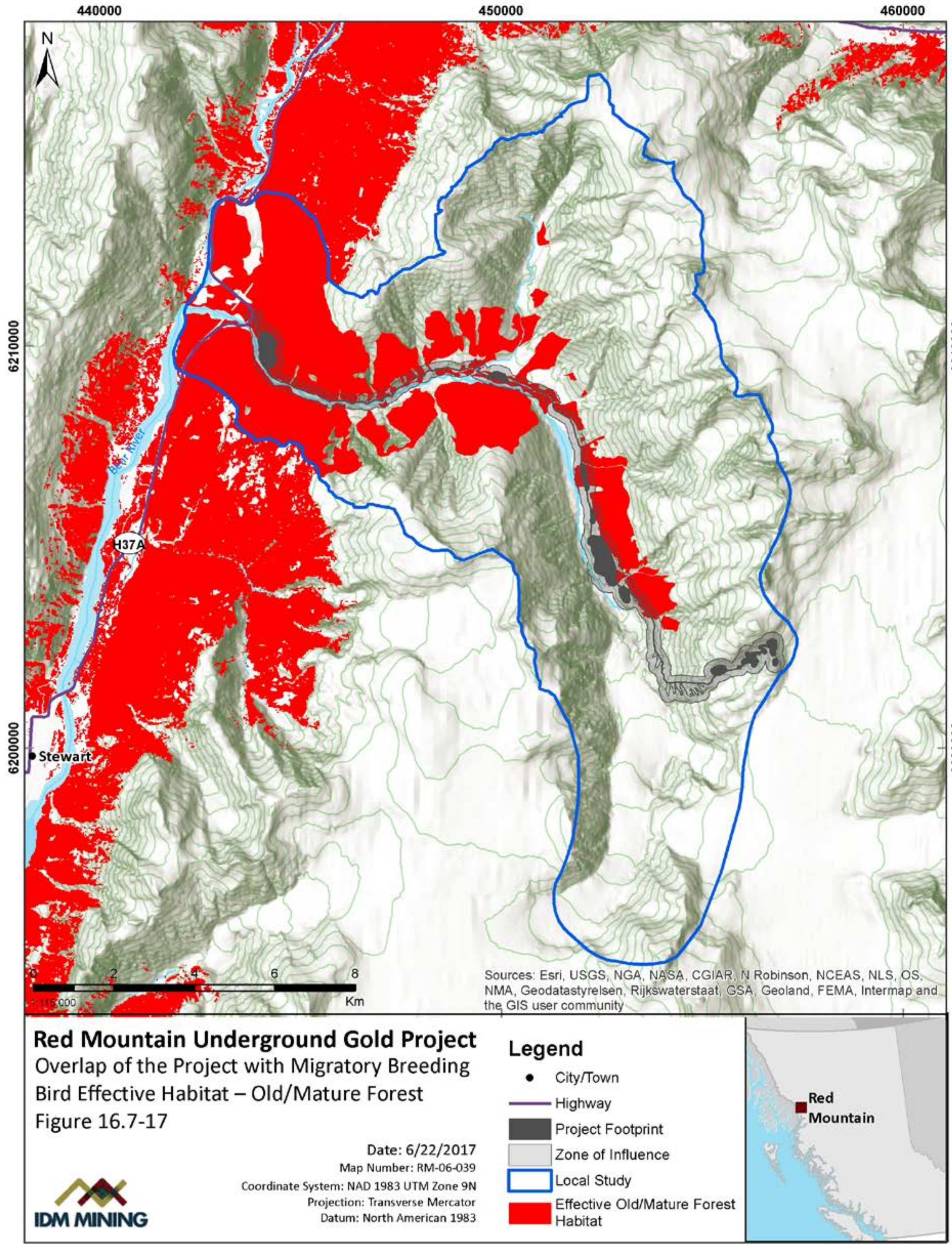


Figure 16.7-18: Overlap of the Project with Migratory Breeding Bird Effective Habitat — Riparian

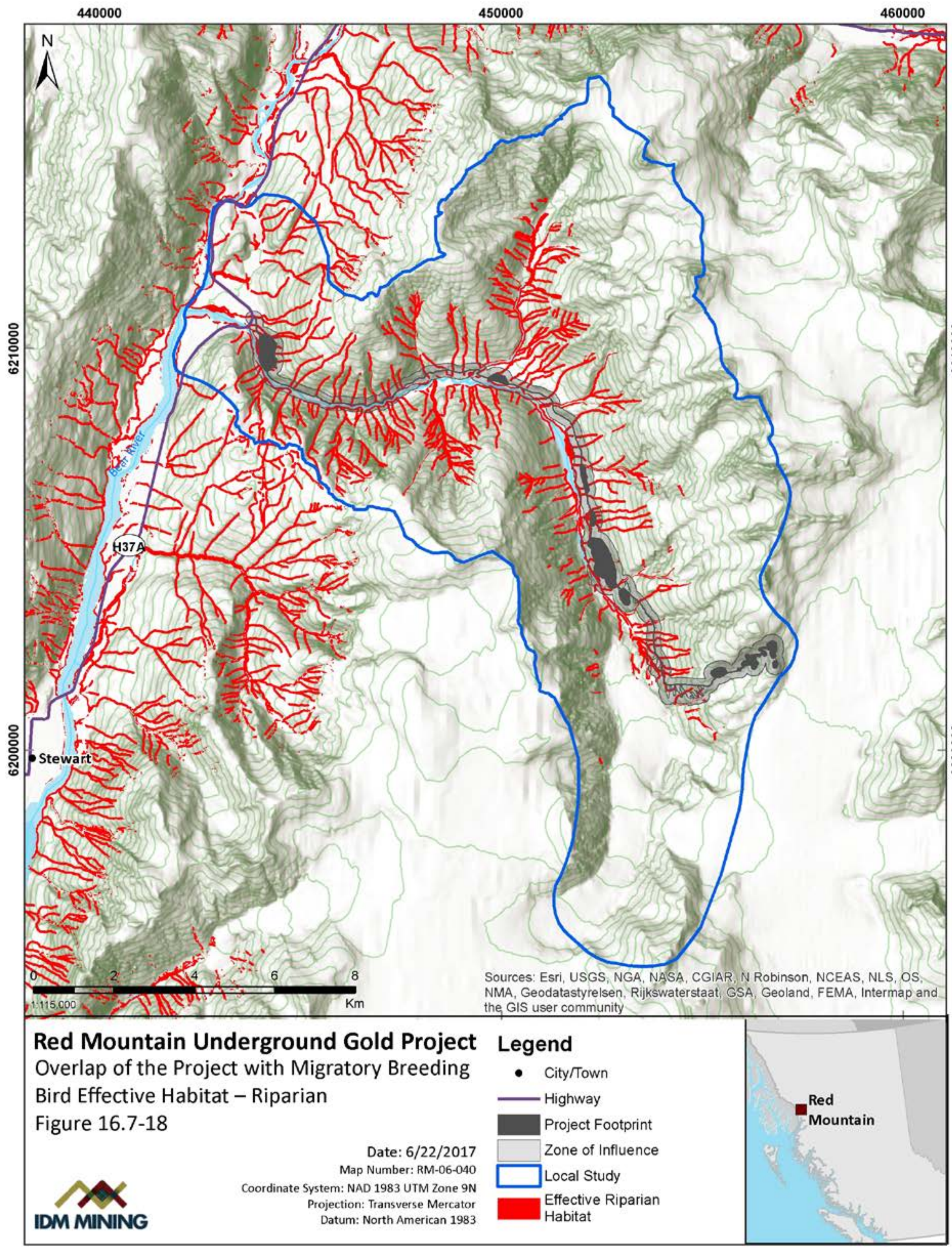
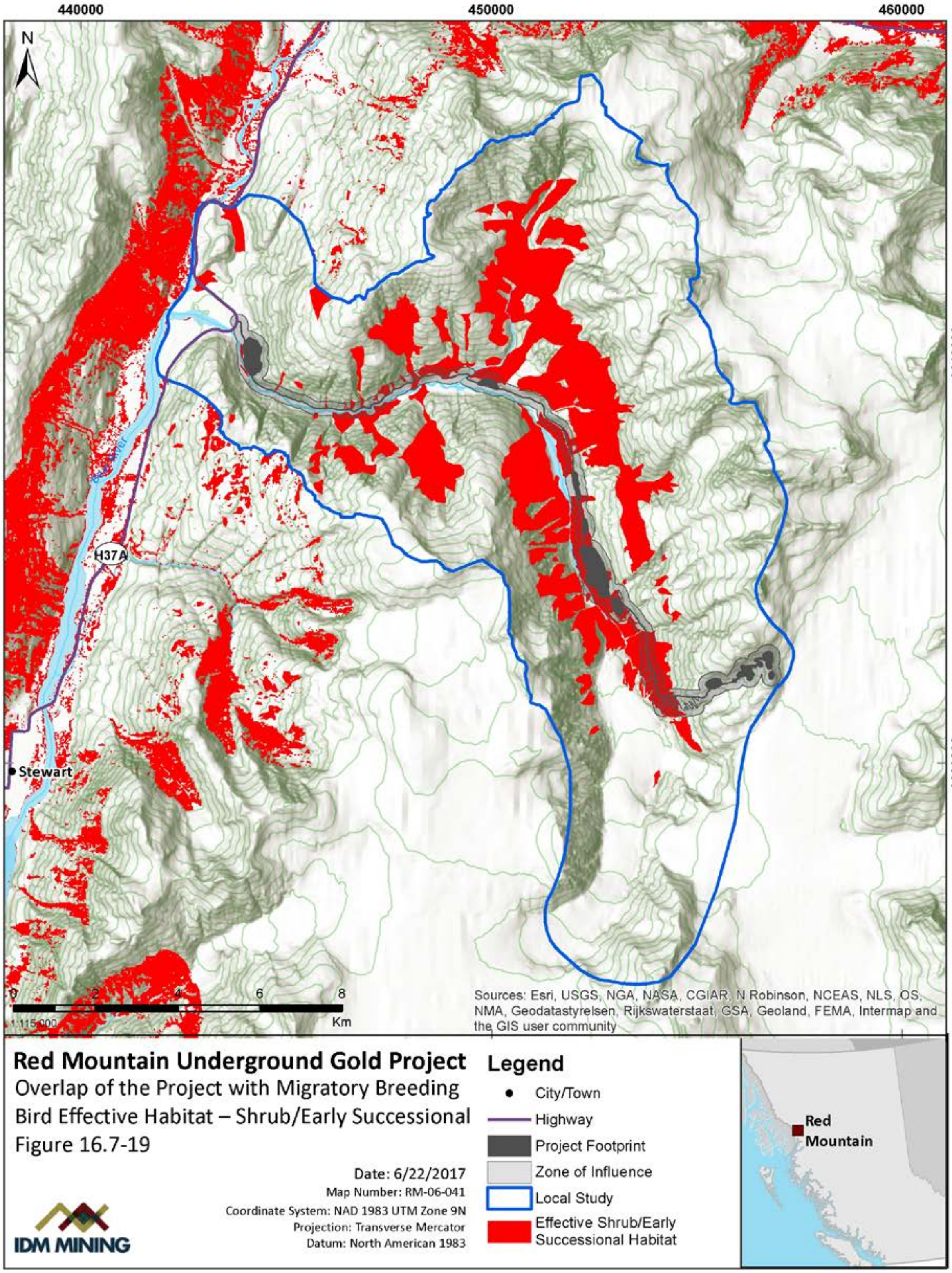


Figure 16.7-19: Overlap of the Project with Migratory Breeding Bird Effective Habitat — Shrub/Early Successional



16.7.9.2 MacGillivray's Warbler

16.7.9.2.1 Habitat Availability

Residual Effect Analysis

The LSA contains 2,258 ha of effective nesting habitat for MacGillivray's warbler (i.e., habitat rated as high or moderate suitability). Project infrastructure related to the Access Road and Process Plant at Bromley Humps overlap with effective habitat for MacGillivray's warbler. Isolated patches of high suitability habitat overlap the Access Road and the TMF, and the Haul Road overlaps a large area of moderate quality habitat at the head of the Bitter Creek valley.

There are 63 ha of effective habitat for MacGillivray's warbler within the proposed Project footprint (Table 16.7-11; Figure 16.7-20). An additional 108 ha of effective habitat within 150 m of the Project footprint will be affected by sensory disturbance. In total, the habitat assessment indicated that 171 ha of effective habitat may be lost or altered due to the Project footprint and sensory disturbance within 150 m of the Project footprint (Table 16.7-11). This represents 8% of the effective habitat for MacGillivray's warbler in the LSA and less than 1% of effective habitat within the RSA.

Table 16.7-11: Summary of Change in Habitat Availability — MacGillivray's Warbler

Habitat Type	Area of Altered Habitat (ha)	Area of Sensory Disturbance (ha)	Total Habitat Change (ha)	LSA – Total Habitat (ha)	LSA – Habitat Change (%)	RSA – Total Habitat (ha)	RSA– Habitat Change (%)
Nesting	63	108	171	2,258	8	23,805	<1

Characterization of Residual Effect

The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The magnitude of effect to habitat availability for MacGillivray's warbler was rated low, because less than 1% of the effective nesting habitat within the RSA will be affected by the Project. The geographical extent of effects on habitat availability for MacGillivray's warbler will be limited to the LSA (i.e., Local). The duration of Project effects on habitat availability will be long-term. Altered habitat within the Project footprint, 63 ha of effective habitat, will take many years to fully recover following disturbance. However, because MacGillivray's warblers use early successional habitat, habitat suitability will start to return relatively quickly for this species. The area affected by sensory disturbance, 108 ha of effective habitat, will return to the original habitat effectiveness following the Project Closure and Reclamation Phase. The effects of habitat alteration and sensory disturbance will be continuous throughout the Project but are considered reversible once mining activities cease and reclamation occurs. Context for MacGillivray's warbler is rated as high. This species uses early successional habitat for nesting and foraging. Human activity that creates early successional habitat, such as logging and mineral exploration, is thought to have increased habitat availability for this species (Nitschke 2008; Pitocchelli 2013).

Likelihood

High. Effective habitat will overlap with the Project footprint and also be subject to sensory disturbance from Project activities.

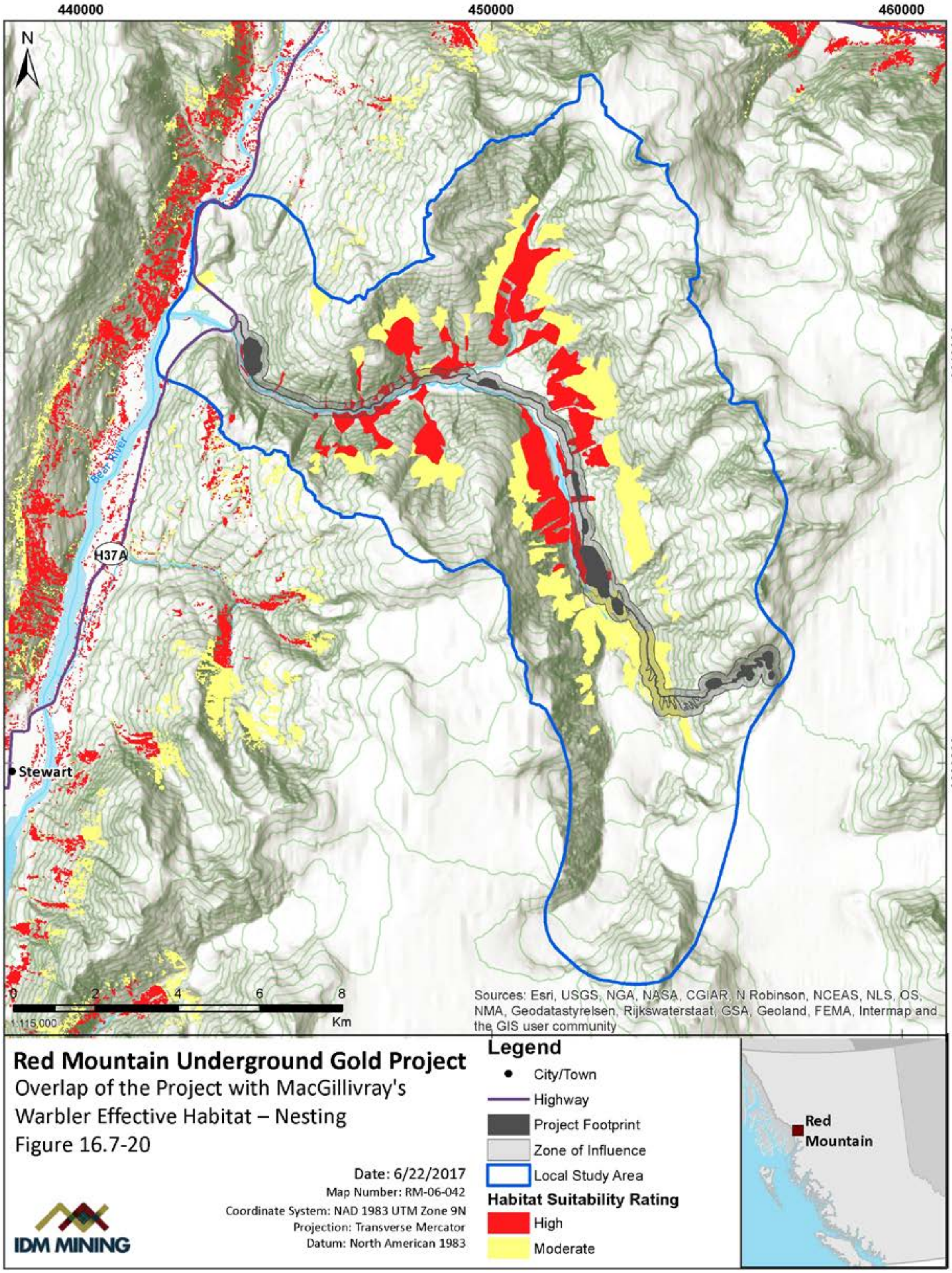
Significance

Not Significant. Project effects on habitat availability for MacGillivray's warbler are not significant because any residual effect will have a low magnitude, a local extent, and be reversible. MacGillivray's warblers are also considered to have high resilience to changes in habitat availability. Based on these criteria it is unlikely that the project will have a measurable effect on the size or viability of the MacGillivray's warbler population within the RSA.

Confidence and Risk

High. There is a good understanding of the cause-effect relationship between the Project and MacGillivray's warbler habitat availability. The primary uncertainty is in how far habitat effects from sensory disturbance will extend beyond the Project footprint. The 150 m ZOI around the Project infrastructure likely overestimates potential Project effects on habitat availability. There is very low risk that the Project effects could exceed those used in this assessment.

Figure 16.7-20: Overlap of the Project with MacGillivray's Warbler Effective Habitat — Nesting



16.7.10 Potential Residual Effects Assessment — Migratory Bird Species at Risk

This section describes the nature of Project-related residual effects identified with respect to migratory birds that are at risk provincially and/or federally. This includes black swift, common nighthawk, marbled murrelet, and olive-sided flycatcher.

Potential residual effects to migratory bird species at risk include habitat alteration, sensory disturbance, direct mortality, indirect mortality, chemical hazards, and attractants. Potential Project-related effects habitat disruption and indirect mortality were determined to have no direct interaction related to birds (see Section 16.5.2).

The potential residual effects of the Project on migratory bird species at risk are addressed by a combination of mitigation measures as described in Section 16.6 and the WMP (Volume 5, Chapter 29). Mitigation measures that will minimize potential residual effects include Project design measures, minimizing habitat disturbance, avoiding disturbance during the breeding season, conducting pre-clearing nest surveys during the breeding season if disturbance cannot be avoided, managing vehicle traffic (e.g., speed limits), preventing wildlife entrapment in Project infrastructure, and managing chemical hazards and attractants.

Following the successful implementation of the mitigation measures described in Section 16.6 and the WMP, mortality risk was not considered a residual effect for migratory breeding birds species at risk and was not carried forward into the effects assessment, with exception of common nighthawk and marbled murrelet. Mortality risk is expected to be effectively mitigated through the identification and buffering of active bird nests and habitat features. Direct mortality related to collisions with vehicles and the Powerline is a possibility and will be reduced by standard vehicle mitigation (e.g. traffic limitations and speed reduction), Project design, and best practices related to transmission lines (see WMP Volume 5, Chapter 29 for further details).

The residual effects that are anticipated to remain following mitigation with respect to migratory bird species at risk are: habitat availability (including habitat alteration and sensory disturbance) and direct mortality for common nighthawk and marbled murrelet only. These two species have potential for a measureable increase in mortality risk as a result of the Project due to their specific vulnerabilities that are discussed in the effects assessments below. For the remaining species within this VC, mortality risk is not expected to result in a measureable effect as a result of the Project and is not considered a residual effect. This is based on review of their main threats and literature or lack thereof related to mortality, application of mitigation measures, and consideration of traffic volumes in this assessment (see discussion in Section 16.7.10.2.2).

16.7.10.1 Black Swift

16.7.10.1.1 Habitat Availability

Habitat availability for black swift includes changes to the amount or quality of effective nesting habitat (i.e., habitat rated as suitable) as a result of habitat alteration or sensory disturbance. Habitat alteration was assessed quantitatively within the LSA and RSA by calculating how much effective nesting habitat overlapped with the Project footprint. Sensory disturbance was assessed quantitatively within the LSA and RSA by calculating how much effective nesting habitat overlapped within the ZOI. The ZOI for black swift included 150 m around the Project footprint and the area where modelling predicted continuous emission of noise above 45 dBA/55 dBA (rationale in Table 16.3-5). The habitat ratings within the ZOI were downgraded from suitable to unsuitable.

The LSA contains 263 ha of effective habitat for black swift (Table 16.7-12; Figure 16.7-21). These habitats occur sporadically throughout the LSA at low- to mid-elevations and in many cases adjacent to Project infrastructure related to the Access Road, TMF, and Process Plant at Bromley Humps. The habitat assessment indicated that 55 ha of effective habitat may be lost or altered due to the combined Project footprint and area of sensory disturbance. This represents a 3% loss of effective habitat within the RSA.

Table 16.7-12: Summary of Change in Habitat Availability — Black Swift

Habitat Type	Area of Altered Habitat (ha)	Area of Sensory Disturbance (ha)	Total Habitat Change (ha)	LSA – Total Habitat (ha)	LSA – Habitat Change (%)	RSA – Total Habitat (ha)	RSA– Habitat Change (%)
Nesting	5	49	55	263	21	2,084	3

Characterization of Residual Effect

The Project is expected to have an adverse effect on black swift effective nesting habitat due to habitat alteration and sensory disturbance. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The combined effects are considered to have a low magnitude at the RSA level as a maximum of 3% of the effective RSA nesting habitat will be directly or indirectly affected by Project activities. The geographic extent of the combined effects is expected to be local. Habitat alteration and sensory disturbance are expected to be long-term in duration with effects occurring from the Construction Phase to the Closure and Reclamation Phase. The effects of habitat alteration and sensory disturbance will be continuous throughout the Project, but are considered reversible once mining activities cease and reclamation occurs. Context is considered low because black swift are a species at risk in Canada that require highly specific nest site attributes and have a very high nest-site fidelity (Campbell et al. 1990).

It is speculated that the main threats to this species are airborne pollutants (pesticides) that influence aerial invertebrate biomass and climate change (i.e., drought, storms, flooding, extreme temperatures) that could affect the habitat suitability of nest sites or lead to changes in aerial arthropod phenology in relation to black swift breeding (COSEWIC 2015). This supports characterization of low context because black swift may not be able to respond and adapt to adverse nesting habitat effects as readily as other migratory bird species.

Likelihood

Moderate. This species was observed in the LSA and the combined Project footprint and ZOI will overlap with modelled effective nesting habitat for this species. There is no confirmation of nesting habitat within the LSA.

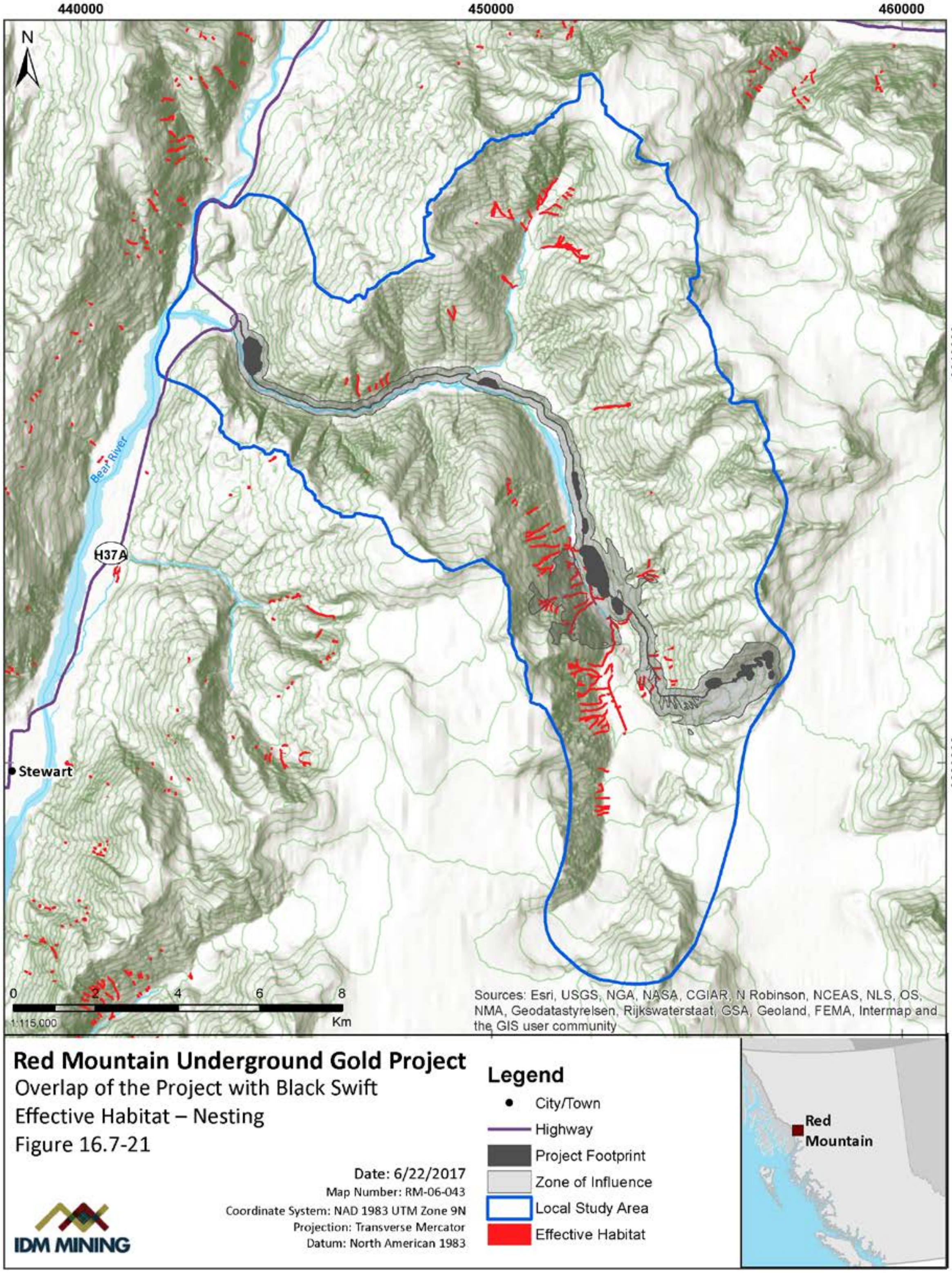
Significance

Not Significant. The combined residual effects of habitat alteration and sensory disturbance are assessed to be not significant for black swift based on a low magnitude, the duration is long-term, and has a regular occurrence. Habitat alteration and sensory disturbance will result in a greater than negligible adverse effect within the LSA, but the effect is considered partially reversible and it is unlikely that these effects would pose a risk to the long-term persistence and viability of black swift at the regional level (i.e., RSA).

Confidence and Risk

Moderate. The primary uncertainty associated with this prediction is the degree to which black swifts are actually displaced by mining operations within the sensory disturbance zones resulting in reduced habitat. Further uncertainty is related to the lack of baseline surveys for black swifts and their nesting habitat within the LSA. The assumptions used in this assessment are precautionary, both in terms of the sizes of the disturbance ZOIs and magnitude of effect (i.e., complete loss of habitat), and likely overestimate potential Project effects on habitat availability. There is very low risk that the Project effects could exceed those used in this assessment. More likely, black swifts will continue to use some portions of the sensory disturbance ZOIs and the effects will be less than those used in this assessment.

Figure 16.7-21: Overlap of the Project with Black Swift Effective Habitat – Nesting



16.7.10.2 Common Nighthawk

16.7.10.2.1 Habitat Availability

Habitat availability for common nighthawk includes changes to the amount or quality of effective nesting habitat as a result of habitat alteration or sensory disturbance. Habitat alteration and sensory disturbance were assessed quantitatively by calculating how much effective nesting habitat overlapped with the Project footprint and with the ZOI, respectively. The ZOI for common nighthawk included 150 m around the Project footprint and the area where modelling predicted continuous emission of noise above 45 dBA/55 dBA beyond 150 m (rationale in Table 16.3-5). All WHRs within the ZOI were downgraded by one class to a minimum of low (i.e., high becomes moderate; moderate becomes low; low stays low; and nil remains nil). The resulting habitat values were then summarized and compared to the available effective nesting habitat within the RSA.

Nesting habitat for common nighthawk can be found in almost any open or semi-open habitat where flying insects are common (Appendix 16-A). The Recovery Strategy for common nighthawk identified loss or degradation of nesting habitat due to clearing as an unknown severity threat with a low casual certainty (EC 2016a). The recovery strategy has also identified reduced availability of insect prey due to loss of insect-producing habitats (i.e., waterbodies) as a moderate severity threat with a medium casual certainty (EC 2016a).

The LSA contains 99 ha of effective nesting habitat for common nighthawk (Table 16.7-13). These habitats occur sporadically throughout the LSA at elevations below approximately 1,300 masl in the CWHwm BGC subzone. Vegetation clearing and ground disturbance within areas of effective nesting habitat that overlap with the Access Road and Process Plant will likely have an adverse effect on common nighthawk. It is unlikely that the Project will reduce the availability of insect prey because there are no wetlands or other large waterbodies within the Project footprint. The habitat assessment indicated that 34 ha of effective nesting habitat for common nighthawk may be adversely affected due to habitat alteration and sensory disturbance (Table 16.7-13). This represents less than 1% of effective nesting habitat within the RSA.

Table 16.7-13: Summary of Change in Habitat Availability — Common Nighthawk

Habitat Type	Area of Altered Habitat (ha)	Area of Sensory Disturbance (ha)	Total Habitat Change (ha)	LSA – Total Habitat (ha)	LSA – Habitat Change (%)	RSA – Total Habitat (ha)	RSA– Habitat Change (%)
Nesting	4	31	34	99	35	4,823	<1

Characterization of Residual Effect

The Project is expected to have an adverse effect on common nighthawk effective nesting habitat due to habitat alteration and sensory disturbance. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The combined effects are considered to have a low magnitude within the context of the RSA because less than 1% of effective nesting habitat will be directly or indirectly affected by the combined Project footprint and ZOI. The geographic extent of the combined effects is expected to be Local and entirely limited to the LSA. Habitat alteration and sensory disturbance are expected to be long-term in duration with effects occurring from the Construction Phase to the Closure and Reclamation Phase. The effects of habitat alteration and sensory disturbance will be continuous throughout the Project, but are considered reversible once mining activities cease and reclamation occurs.

Context is considered low because common nighthawks are a species at risk in Canada that are sensitive to changes in their environment (EC 2016a). It is speculated that an available and constant supply of flying insects is likely the most limiting factor for the species survival (Campbell et al. 2006). Common nighthawks also have a short breeding season that limits them to one brood per season, and clutch size is small (i.e., average two eggs; Campbell et al. 2006; EC 2016a). Therefore, common nighthawks may not be able to respond and adapt to adverse nesting habitat effects as readily as other migratory bird species.

Likelihood

Moderate. The combined Project footprint and ZOI will overlap with modelled effective nesting habitat for this species, and three nighthawks were observed along Highway 37A within approximately 4.5 km of the LSA. There is currently no confirmation of nesting habitat or activity within the LSA for common nighthawk.

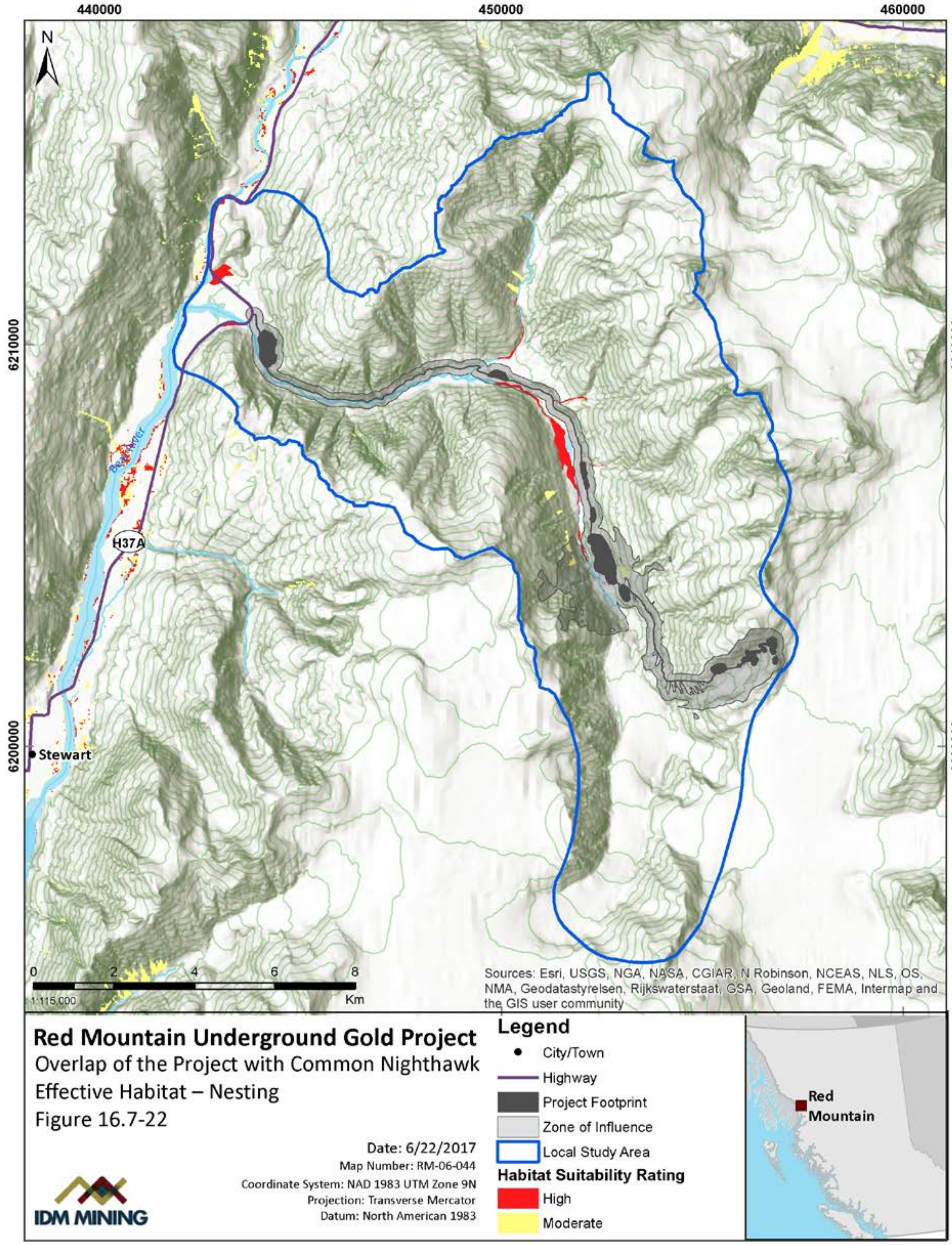
Significance

Not Significant. The combined residual effects of habitat alteration and sensory disturbance are not significant based on low magnitude and local geographic extent. Although habitat alteration and sensory disturbance may result in a greater than negligible adverse effect within the LSA, it is unlikely that these effects would pose a risk to the long-term persistence and viability of common nighthawks at the regional level (i.e., RSA).

Confidence and Risk

Moderate. A habitat model based on well-known habitat requirements for the species was completed in the RSA and the model outputs correlated well with the field observations. However this is moderated by a limited amount of data on the species occurrence in the Project area. The risk of the effects being greater than predicted is low. Mitigation measures are established that have been used effectively on other projects. The Project footprint will be minimized and existing roads will be used to the greatest extent practicable, which will minimize habitat alteration for common nighthawks.

Figure 16.7-22: Overlap of the Project with Common Nighthawk Effective Habitat — Nesting



16.7.10.2.2 Mortality Risk

Mortality risk for common nighthawk includes changes to wildlife mortality via direct pathways, such as incidental take during vegetation clearing and ground disturbance, collisions with Project-related traffic, or collisions and electrocution caused by the Powerline. Direct mortality risk due to incidental take was assessed qualitatively within the context of the LSA. This was achieved by identifying important habitat areas from baseline studies and habitat modelling and assessing them within the context of the LSA and the vegetation clearing/ground disturbance schedule. Direct mortality risk due to collisions with vehicles or the Powerline was assessed qualitatively within the context of the LSA using information from baseline studies and habitat modelling regarding local movement corridors and important habitat areas in relation to Project roads and the Powerline. Project-specific traffic information and information from the literature regarding traffic volumes or power line configurations considered to put birds at risk were also considered.

The habitat assessment indicated that 2 ha (i.e., 2%) of effective nesting habitat in the LSA overlaps with the Project footprint. An area of effective nesting habitat that makes up the vast majority of nesting habitat in the LSA is located adjacent to the Access Road (Figure 16.7-22). This poses a mortality risk through vehicle collisions and a small amount through risk of incidental take. The risk through incidental take will be effectively addressed for this small area (2 ha) through several mitigation measures. Vegetation clearing and ground disturbance will be avoided during the nesting season whenever possible to minimize incidental take. If vegetation clearing and ground disturbance cannot be avoided during the nesting season, a QEP will conduct pre-clearing nest surveys to reduce the risk of incidental take. If a nighthawk nest is identified during these pre-clearing surveys or incidentally during other field activities, an appropriate no-disturbance setback will be established around the nest to minimize disturbance and will remain in place until the nestlings have successfully fledged. These mitigation measures are anticipated to be successful at reducing the risk of incidental take for common nighthawk.

The Recovery Strategy for common nighthawk identified collisions with vehicles, aircraft, and human structures as a moderate severity threat with a medium casual certainty (EC 2016a). Severity reflects the population-level effect of a specific threat and causal certainty reflects the degree of known evidence to support the assessment of a specific threat (EC 2016a). Medium causal certainty indicates a correlation between the threat and population viability (EC 2016a).

Common nighthawks may roost or nest on gravel roads and trails, making them vulnerable to collisions with vehicles and possible nest or brood destruction, especially as the amount of traffic increases (Brigham et al. 2011; Campbell et al. 2006; EC 2016a). Roads that traverse nighthawk foraging habitats can also lead to increased collision risk between vehicles and nighthawks, which forage in open or semi-open areas with flying insects at dawn and dusk, often in large groups (Brigham et al. 2011; Campbell et al. 2006; EC 2016a). One study documented the causes of 477 incidents of nighthawk mortalities into 22 categories. The majority of mortalities were attributed to roadkill (i.e., 38.6%) and museum collecting (i.e., 32%); the remaining mortalities were spread out among the remaining categories (Campbell et al. 2006). The location of effective nesting habitat adjacent to the Access Road is not bisected by the road.

Collisions with vehicles are a significant source of mortality for common nighthawks in southern BC; this is likely due to high densities of nighthawks and roads in this region coupled with high traffic volumes (Campbell et al. 2006). Although nighthawks are distributed widely across BC, they become less common and more localized as latitude and elevation increases; occurrences are rare along the northern mainland coast, often occurring at the head of long inlets (Campbell et al. 2006). The highest nighthawk mortalities from vehicle collisions have been reported in the Okanagan valley and East Kootenay region (Campbell et al. 2006). Annual average daily traffic volume data from major highways in BC indicates that traffic volumes are considerably higher throughout the Okanagan valley and East Kootenay region (i.e., approximately 11,350 and 4,500 vehicles per day, respectively) compared to traffic volumes along Highway 37 and Highway 37A (i.e., 693 and 253 vehicles per day, respectively) (BC MOTI 2017). Furthermore, the expected annual traffic volume for the Project is 15,140 loads over eight years, which equates to 5.18 loads per day. Since traffic on the Access Road will be considerably less than traffic in the Okanagan valley and East Kootenay region, and the density of nighthawks is expected to be much lower in the Bitter Creek valley compared to southern BC, the risk of mortality for common nighthawks due to collisions with Project-related traffic is anticipated to be low. A maximum speed limit of 50 km/hr will be enforced along the Access Road, which will further limit the risk of collision.

Collisions with aircraft can also be a significant source of mortality for birds, particularly during migration (Campbell et al. 2006). Eighty-two percent of bird strikes between August and October at McConnell Air Force Base in Kansas involved nighthawks (Campbell et al. 2006). In BC, common nighthawks have been reported at several airports foraging around artificial lights and roosting on runways, roads, and fields (Campbell et al. 2006). Given that the density of nighthawks is expected to be low in the Bitter Creek valley, helicopter use will be infrequent, and effective nesting habitat is limited for nighthawks within the LSA, the risk of mortality for common nighthawks due to collisions with helicopters is anticipated to be low.

Many bird species are also vulnerable to collisions with buildings, communication towers, wind turbines, transmission lines, and other vertical man-made structures, particularly during migration (Campbell et al. 2006). Common nighthawks are not especially vulnerable to collisions with buildings and communication towers (EC 2016a). The collision risk with wind turbines and other vertical man-made structures has not yet been quantified for common nighthawks (EC 2016a). Although collision risk with transmission lines has not been quantified for common nighthawk, it is presumed to be limited; however, adult males have been known to collide with transmission lines during courtship displays and such collisions may increase as development expands (EC 2016a). Nighthawks may also nest along transmission line corridors if the habitat includes open areas with short vegetation or rock outcroppings (Campbell et al. 2006; Hausleitner and Wallace 2012), which may increase the risk of collisions. Given that the density of nighthawks is expected to be low in the Bitter Creek valley and effective nesting habitat is limited for nighthawks within the LSA, the risk of mortality for common nighthawks due to collisions and electrocution caused by the Powerline is anticipated to be low.

Characterization of Residual Effect

The Project is expected to have an adverse effect on common nighthawk mortality risk due to potential incidental take during vegetation clearing and ground disturbance, collisions with Project-related traffic, and collisions and electrocution caused by the Powerline. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The effects are considered to have a low magnitude within the context of the LSA because the density of nighthawks is expected to be low in the Bitter Creek valley and the effective nesting habitat area is very small for nighthawks within the LSA. The geographic extent of the effects is expected to be discrete and entirely limited to the Project footprint. Mortality risk is expected to be long-term in duration and sporadic in frequency with effects possible from the Construction to the Closure and Reclamation Phase. Mortality risk is considered fully reversible once mining activities cease.

Context is considered low because common nighthawks are a species at risk in Canada that are sensitive to changes in their environment (EC 2016a). It is speculated that an available and constant supply of flying insects is likely the most limiting factor for the species survival (Campbell et al. 2006). Common nighthawks also have a short breeding season that limits them to one brood per season, and clutch size is small (i.e., average two eggs; Campbell et al. 2006; EC 2016a). Therefore, common nighthawks may not be able to respond and adapt to adverse effects as readily as other migratory bird species.

Likelihood

Low. The density of nighthawks is expected to be low in the Bitter Creek valley and effective nesting habitat is limited for nighthawks within the LSA. Only three nighthawks were observed during baseline studies, all along Highway 37A within approximately 4.5 km of the LSA. There is currently no confirmation of nesting habitat or activity within the LSA for common nighthawk.

Significance

Not Significant. The residual effect of mortality risk is not significant for common nighthawk based on low magnitude, discrete geographic extent, sporadic frequency, and complete reversibility. Although mortality risk may result in a greater than negligible adverse effect within the Project footprint, it is unlikely that these effects would pose a risk to the long-term persistence and viability of common nighthawks at the regional level (i.e., RSA).

Confidence and Risk

High. Habitat preferences of common nighthawk are well known and considerable data exist that quantifies the risk of mortality in various traffic volumes and other pathways. Furthermore, effective and tested mitigation measures will be in place to limit the effect. There is low risk that the effect will be higher than predicted. The precautionary approach was used in this assessment considering the area of habitat that overlaps with the Project footprint is small (2 ha).

16.7.10.3 Marbled Murrelet

Marbled murrelet were assessed for potential Project effects of habitat availability (including habitat alteration and sensory disturbance), habitat distribution, and mortality risk. Even with the application of mitigation measures (Table 16.6-1), habitat alteration and sensory disturbance (measured as habitat availability) and mortality risk are anticipated to be residual effects.

Habitat distribution is not expected to be a residual effect for the following reasons. Marbled murrelet are thought to select nest trees based on nest tree and patch characteristics. Nest trees require large mossy platforms with an accessible flyway and sufficient protection from predators (Hamer and Nelson 1995; Burger 2002). Adjacent canopy cover should similarly provide access to the nest tree but also some cover from predation. Variables at the patch scale (0.2 to 2.0 ha) such as platform tree density, height and diameter as well as landscape-level attributes such as elevation, aspect and slope have been found to the best predictors of occupied nesting habitat (Silvergieter and Lank 2011).

The above suggests large contiguous stands with suitable nesting habitat characteristics are not critical for marbled murrelet nesting habitat and that patchiness is not a strong predictor of occupancy. Furthermore, most suitable nesting habitat is constrained to the CWH BGC zone within valley bottoms and lower slope positions. Potential Project interactions within this zone are primarily limited to the Access Road, and small forest openings are not anticipated to have negative effects on habitat fragmentation or movement. As a result, habitat distribution is not considered to be a residual effect for marbled murrelet.

16.7.10.3.1 Habitat Availability

Habitat availability for marbled murrelet includes direct and indirect effects to effective breeding habitat. Effective habitat is defined as the sum of class 1 (very high), 2 (high), and 3 (moderate) rated habitat. Class 3 habitat is included as suitable habitat for marbled murrelet since the accepted Provincial standards describe it as “nesting likely but at moderate to low densities” (Burger 2004). Potential direct effects include vegetation clearing for Project construction.

Indirect effects include indirect habitat alteration adjacent to vegetation clearing that result from edge effects, such as increased insolation and exposure to wind. These effects have been identified as occurring up to about 140 m from “hard” edges (i.e., those with a dramatic change in structure), such as old-growth forest adjacent to a recent clearing (e.g., Chen et al. 1992, Voller 1998), but can extend as far as 240 m in extreme circumstances, for example an old-growth forest edge exposed to extreme heat and wind on a southern exposure (Chen 1991).

Indirect edge effects can also include a greater risk of predation, though the potential for, degree of, and distance over which increased predation may occur is highly variable (Vetter et al. 2012). On Vancouver Island, predation on artificial nests was greatest within the first 10 m of a hard edge, decreased up to 130 m, and was not detectable at 200 m. The same study found that Steller’s jay was the most abundant predator of marbled murrelet nests, and that its density was greater at clear-cut and road edges than within forest interiors or at river edges (Burger et al. 2004).

As a result of these potential indirect effects, a ZOI of 300 m has been used to estimate potential indirect effects to marbled murrelet nesting habitat (justification described in Table 16.3-5). This is considered a conservative estimate and is more likely to over-estimate rather than under-estimate indirect Project effects.

Effects to habitat as a result of sensory disturbance caused by noise during construction or operation are not included in the indirect effects assessment. Marbled murrelets are daily migrators, primarily migrating at or around dawn and dusk. Incubation lasts 27 to 30 days during which, pairs typically exchange duties at dawn and have 24-hour shifts (Hamer and Nelson 1995). Feeding occurs primarily, though not exclusively, at or around dawn and dusk (Hamer and Nelson 1995). Chicks fledge at around 27 to 40 days (Hamer and Nelson 1995). Due to their crepuscular timing, daytime noise disruptions are expected to be less than for other species. Further, 96% of atlassed marbled murrelet nests have been found below 250 masl with only one record above 500 masl (Burger 2015). The bulk of the Project's operational activity will occur at relatively high elevation near the Mine Site; for example, the main portal will be at approximately 1,860 masl while the haulage ramp will be above 1,700 masl. This further reduces the potential for interaction between marbled murrelet nesting and operational activities.

The assessment of effects on marbled murrelet habitat used the products of two different models. Project-specific models were created based on the TEM mapping within the Project LSA and the PEM mapping within the RSA. These models were based on mapped and field verified habitat attributes and are described further in the Wildlife Baseline Report (Appendix 16-A). The TEM model results are considered the best estimate of effective habitat within the LSA due to the higher level of field studies within the LSA, and because the habitat attributes available within the TEM data are consistent with the parameters identified within the model. Modelling methodologies follow Burger (2004) and are consistent with subsequent advice provided by CWS. Modelling results have been used to estimate the area of direct and indirect effects to marbled murrelet habitat within the Project footprint and the ZOI. For comparative purposes, the results of the Provincial Marbled Murrelet nesting habitat suitability model (Mather et al. 2010) are also presented, though they do not cover the entire LSA or RSA.

In the PEM data, structure classes 5 (young forest) to 7 (old forest) are not differentiated from each other. Since marbled murrelet primarily use old forest stands, the PEM model over-estimates effective habitat. As a result, comparison of effected habitat within the Project footprint and ZOI relative to available habitat within the RSA (Table 16.7-14) would tend to be an underestimate of actual proportions.

The results of the marbled murrelet Nesting Habitat Suitability Model for the British Columbia Coast (i.e., BC Model; Mather et al. 2010) were used to compare relative amounts of habitat within the Project footprint and ZOI relative to the RSA. Since the methods used are the same in all three areas, it should provide a more realistic estimate of this proportion. The primarily limitation of the Provincial data is that it is based upon coarser base mapping and is intended for estimates of regional, not site-specific, habitat availability. Further, it is a bivariate model, identifying suitable and non-suitable habitat and therefore cannot be used to elucidate relative habitat quality. Finally, available model results cover approximately half of the LSA and RSA (approximately 120,000 ha or 58%). As a result, these model results are presented for comparative purposes only. Figure 16.7-23 shows the overlap of effective marbled murrelet habitat using the two different models.

Potential direct effects include the alteration of a total of 3 ha of effective marbled murrelet nesting habitat in the Project footprint, representing less than 1% of the available habitat in the RSA when compared against the TEM/PEM model (Table 16.7-14). Indirect effects include a total of 92 ha, representing 3% of the RSA.

Table 16.7-14: Summary of Habitat Availability — Marbled Murrelet: TEM/PEM Model

Area of Altered Habitat (ha)[1]	Area of Sensory Disturbance (ha)[1]	Total Habitat Change (ha)[1]	LSA – Total Habitat (ha)[1]	LSA – Habitat Change (%)[1]	RSA – Total Habitat (ha)[2]	RSA– Habitat Change (%)[3]
3	92	95	162	59	2,971	3

[1]Based on TEM model results
[2]Based on PEM model results
[3]TEM model results within Project footprint and ZOI/PEM model results in the RSA

The BC Model shows substantially less effective habitat within the Project footprint and LSA (Table 16.7-15). Overall, the TEM/PEM model identified approximately 1% of the LSA as effective nesting habitat, while the BC Model identified less than 1% of the LSA as effective nesting habitat. At the RSA level, the TEM/PEM model identified approximately 1% of the RSA as effective nesting habitat, while the BC Model identified less than 1% of the RSA as effective nesting habitat. The actual proportion of effective nesting habitat within the LSA and RSA is likely between these ranges, suggesting the actual proportion of available suitable nesting habitat affected by the Project is likely at or less than 1% within the LSA and at or less than 3% within the RSA.

Table 16.7-15: Summary of Habitat Availability — Marbled Murrelet: BC Model

Area of Altered Habitat (ha)	Area of Sensory Disturbance (ha)	Total Habitat Change (ha)	LSA – Total Habitat (ha)	LSA – Habitat Change (%)	RSA – Total Habitat (ha)	RSA– Habitat Change (%)
0	0	0	<1	0	<1	0

According to the TEM/PEM model, a total of 95 ha of suitable nesting habitat for marbled murrelet may be adversely affected due to habitat alteration and sensory disturbance (Table 16.7-14). This represents less than 1% of the habitat in excess of the minimum habitat retention level for marbled murrelet in the Northern Mainland Coast conservation region as of 2011 (i.e., 127,570 ha). According to the BC Model, 0% of suitable nesting habitat for marbled murrelet may be adversely affected due to habitat alteration and sensory disturbance (Table 16.7-15). Therefore, Project-related effects on suitable nesting habitat for marbled murrelet are not likely to compromise the minimum habitat retention level for the Northern Mainland Coast conservation region.

Characterization of Residual Effect

The Project is expected to have an adverse effect on marbled murrelet effective nesting habitat through habitat alteration associated with vegetation clearing and indirect edge effects and through predation risk. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The combined effects are considered to have a low magnitude since less than 5% of available habitat will be altered, either directly or indirectly. The geographic extent of the combined effects is local and entirely limited to the LSA. Habitat alteration will be long-term in duration since cleared areas will not return to effective habitat within the life scale of the Project. The effects of habitat alteration and sensory disturbance will be continuous throughout the Project but are considered reversible once mining activities cease and reclamation occurs.

Context is considered moderate because marbled murrelet are a species at risk in Canada and may not be able to respond and adapt to adverse nesting habitat effects as readily as other migratory bird species.

Likelihood

Moderate. Effective habitat will be altered but local populations are not well understood. If regional populations are very low, habitat is not expected to be a limiting resource.

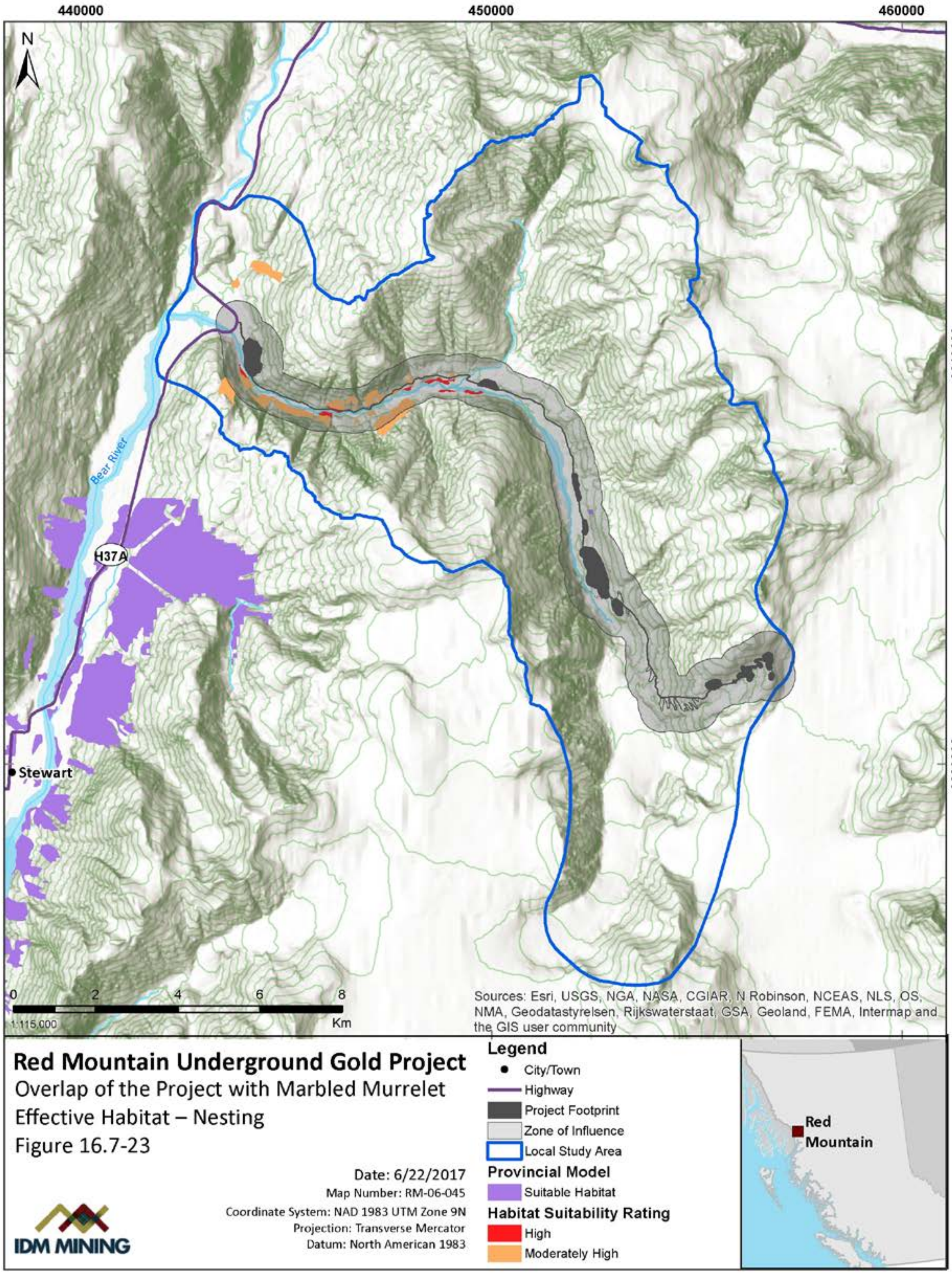
Significance

Not Significant. The combined residual effects of habitat alteration and sensory disturbance are not significant based on low magnitude and local geographic extent. Although habitat alteration may result in a greater than negligible adverse effect within the LSA, it is unlikely that these effects would pose a risk to the long-term persistence and viability of marbled murrelets at the regional level (i.e., RSA).

Confidence and Risk

Moderate. There is high confidence in the TEM model results and moderate confidence in the PEM model and BC Model results. Confidence in the occurrence of marbled murrelet is low since formal surveys have not been completed. The primary uncertainty associated with the decision is related to knowledge regarding local populations. Little information is available on the presence or nesting behaviour of marbled murrelet within the RSA. The assumptions used in this assessment are precautionary, both in terms of the sizes of the disturbance ZOIs and magnitude of effect (i.e., complete loss of habitat), and likely overestimate potential Project effects on habitat availability. There is very low risk that the Project effects could exceed those used in this assessment. More likely, marbled murrelets, if present, would continue to some use portions of the sensory disturbance ZOIs and the effects will be less than those used in this assessment.

Figure 16.7-23: Overlap of the Project with Marbled Murrelet Effective Habitat – Nesting



16.7.10.3.2 Mortality Risk

Mortality risk for marbled murrelet includes potential direct mortality resulting from incidental take during vegetation clearing and ground disturbance during construction. Collisions with vehicles or Project infrastructure are considered highly unlikely since marbled murrelets fly at or above forest canopies, except when landing at their nests; this risk is not considered further here. Potential collisions with the Powerline are considered a medium level of concern according to the Recovery Strategy for the marbled murrelet in Canada (EC 2014a), but the causal certainty is considered low (i.e., the threat is assumed or plausible). As a result, this potential effect is considered further here.

As many as 245 bird species are known to collide with powerlines (Bevanger 1999). Although no records of collisions of marbled murrelets with power lines could be found, collisions with power lines are rarely observed in the field and likely often go undetected (Beaulaurier 1981). Species with high wing-loading and low maneuverability, such as waterfowl, are thought to be at particular risk of collisions with power lines (Bevanger 1999). Marbled murrelets fly at high speeds (70 to 100 km/hr) in low light conditions (Burger 2002), which may increase the risk of collision with power lines. Marbled murrelets apparently have good vision under low light levels, since they are able to find nests under forest canopies at dawn and dusk; however, power lines are thin and can be difficult to see even with good vision.

Little empirical data is available on the flight height of marbled murrelet, especially in differing weather and topographic conditions, both of which can constrain flight paths. On the Olympic Peninsula, Washington, mean flight height above the ground was 246 m with a range between 62 m and 663 m and 50% within 196 and 286 m (Stumpf et al. 2011). Over two years on western Vancouver Island, mean flight height was found to range between 563 and 687 m and the lowest detection among 955 detections was 99 m; however the cloud ceiling was high or unlimited during each survey and topography was moderately restrictive (Redden et al. 2012).

These data suggest the risk of marbled murrelet collision with the Powerline is low. Power line height is anticipated to range between 5 and 10 m above the ground surface, but longer spans with wires at greater heights are possible. As a result, the risk of collision cannot be entirely dismissed.

Characterization of Residual Effect

The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The magnitude of effects on direct mortality are considered low and depend, in part, on better understanding of local populations. Collisions with the Powerline are considered unlikely; however, if populations are low, mortality of one or more individuals could have a moderate effect on the local population. Residual effects of mortality are considered local because any mortality would occur within the LSA. The duration is considered long-term because mortalities would occur any time during the Construction, Operation, and Closure and Reclamation Phase. Frequency of this effect is sporadic as mortalities are expected to be rare, with the highest risk occurring during the nesting period. The effects of mortality are considered reversible, assuming local populations are adequately robust to compensate for mortality.

Context is considered moderate because marbled murrelet are a species at risk in Canada and may not be able to respond and adapt to adverse nesting habitat effects as readily as other migratory bird species.

Likelihood

Moderate. It is expected that the mitigation measures outlined in Section 16.6 will be effective in reducing direct mortality risk for marbled murrelet, but there is still a low probability that some mortalities may occur during the life of the Project.

Significance

Not Significant. There may be residual effects of direct mortality on marbled murrelet; however, these effects are not significant because they are low in magnitude, local in extent, and reversible.

Confidence and Risk

Moderate. The primary uncertainty associated with the decision is related to the risk of collision with the Powerline. Little information is available on the risk of marbled murrelet collisions with the Powerline or on the status of local populations. The assumptions used in this assessment are precautionary in terms of the potential for collisions. Current information indicates that marbled murrelets generally flight well above the height of the Powerline during daily migrations and the assessment likely overestimates the potential for collisions. There is very low risk that the Project effects could exceed those used in this assessment. More likely, marbled murrelets, if present, will fly well above any power lines and the effects will be less than those used in this assessment.

16.7.10.4 Olive-sided Flycatcher

16.7.10.4.1 Habitat Availability

Habitat availability for olive-sided flycatcher includes changes to the amount or quality of effective nesting habitat (i.e., nesting habitat rated as moderate or high suitability) as a result of habitat alteration or sensory disturbance. Habitat alteration was assessed quantitatively within the LSA and RSA by calculating how much effective nesting habitat overlapped with the Project footprint. Sensory disturbance was assessed quantitatively within the LSA and RSA by calculating how much effective nesting habitat overlapped with the ZOI. The ZOI for olive-sided flycatcher included 150 m around the Project footprint and the area where modelling predicted continuous emission of noise above 45 dBA beyond 150 m (rationale in Table 16.3-5). All WHRs within the ZOI were downgraded by one class. The 45 dBA noise threshold was based on recommended noise thresholds from government guidelines (EC 2009).

The LSA contains 809 ha of effective nesting habitat for olive-sided flycatcher (i.e., habitat rated as moderate or high suitability.

Characterization of Residual Effect

No olive-sided flycatchers were recorded within the LSA and there is not enough high-suitable habitat mapped within the LSA to maintain a large population within this drainage. There will be adverse effects to habitat availability at a low magnitude in the RSA level. Less than 1% of the effective RSA nesting habitat will be directly or indirectly affected by Project activities. The geographic extent of the combined effects is expected to be local. Habitat alteration and sensory disturbance are expected to be long-term in duration with effects occurring from the Construction Phase to the Closure and Reclamation Phase. The effects of habitat alteration and sensory disturbance will be continuous throughout the Project but are considered reversible once mining activities cease and reclamation occurs. Context is considered low because olive-sided flycatcher is a species at risk in Canada where the cause of the population decrease is not well understood (EC 2016b). It is speculated that an available and constant supply of flying insects is likely a limiting factor for the species survival and it is currently unknown whether the availability of nesting habitat is a limiting factor in Canada (EC 2016b). Therefore, olive-sided flycatcher may not be able to respond and adapt to adverse nesting habitat effects as readily as other migratory bird species.

Likelihood

High. The combined Project footprint, 150 m ZOI, and 45 dBA noise threshold overlap with 150 ha of effective nesting habitat within the RSA.

Significance

Not Significant. The combined residual effects of habitat alteration and sensory disturbance are not significant based on the low magnitude, the long-term duration, and regular occurrence. Habitat alteration and sensory disturbance will result in a greater than negligible adverse effect within the LSA, but the effect is considered reversible, and it is unlikely that these effects would pose a risk to the long-term persistence and viability of olive-sided flycatcher at the regional level (i.e., RSA).

Confidence and Risk

Moderate. The cause-effect relationships between the Project and olive-sided flycatcher are not fully understood. Baseline surveys for olive-sided flycatcher were conducted in the LSA within general breeding bird surveys. Habitat preferences of olive-sided flycatcher are well understood; the habitat was modelled across the RSA, and modeled suitability ratings correlated well with field observations.

The primary uncertainty associated with this prediction is the degree to which olive-sided flycatcher are actually displaced by mining operations within the sensory disturbance zones resulting in reduced habitat. The assumptions used in this assessment are precautionary, both in terms of the sizes of the disturbance ZOIs and magnitude of effect (i.e., complete loss of habitat), and likely overestimate potential Project effects on habitat availability. There is very low risk that the Project effects could exceed those used in this assessment. More likely, olive-sided flycatcher will continue to some use portions of the sensory disturbance ZOIs and the effects will be less than those used in this assessment

This habitat occurs sporadically throughout the LSA at low elevations in valley bottoms and in many cases adjacent to Project infrastructure related to the Access Road and Process Plant at Bromley Humps. Olive-sided flycatchers have relatively large home ranges that can vary from 10 to 20 ha in size (EC 2016b) and this variation is dependent on landscape features.

The habitat assessment indicated that 150 ha of effective nesting habitat may be lost or altered due to the combined Project footprint and area of sensory disturbance (Table 16.7-16). This represents less than 1% loss of effective habitat within the RSA.

Table 16.7-16: Summary of Change in Habitat Availability — Olive-sided Flycatcher

Habitat Type	Area of Altered Habitat (ha)	Area of Sensory Disturbance (ha)	Total Habitat Change (ha)	LSA – Total Habitat (ha)	LSA – Habitat Change (%)	RSA – Total Habitat (ha)	RSA– Habitat Change (%)
Nesting	35	115	150	809	19	32,743	<1

Characterization of Residual Effect

No olive-sided flycatchers were recorded within the LSA and there is not enough high suitable habitat mapped within the LSA to maintain a large population within this drainage. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. There will be adverse effects to habitat availability at a low magnitude in the RSA level. Less than 1% of the effective RSA nesting habitat will be directly or indirectly affected by Project activities. The geographic extent of the combined effects is expected to be local. Habitat alteration and sensory disturbance are expected to be long-term in duration with effects occurring from the Construction Phase to the Closure and Reclamation Phase. The effects of habitat alteration and sensory disturbance will be continuous throughout the Project but are considered reversible once mining activities cease and reclamation occurs. Context is considered low because olive-sided flycatcher is a species at risk in Canada where the cause of the population decrease is not well understood (EC 2016b). It is speculated that an available and constant supply of flying insects is likely a limiting factor for the species survival and it is currently unknown whether the availability of nesting habitat is a limiting factor in Canada (EC 2016b). Therefore, olive-sided flycatcher may not be able to respond and adapt to adverse nesting habitat effects as readily as other migratory bird species.

Likelihood

High. The combined Project footprint, 150 m ZOI, and 45 dBA noise threshold overlap with 150 ha of effective nesting habitat within the RSA.

Significance

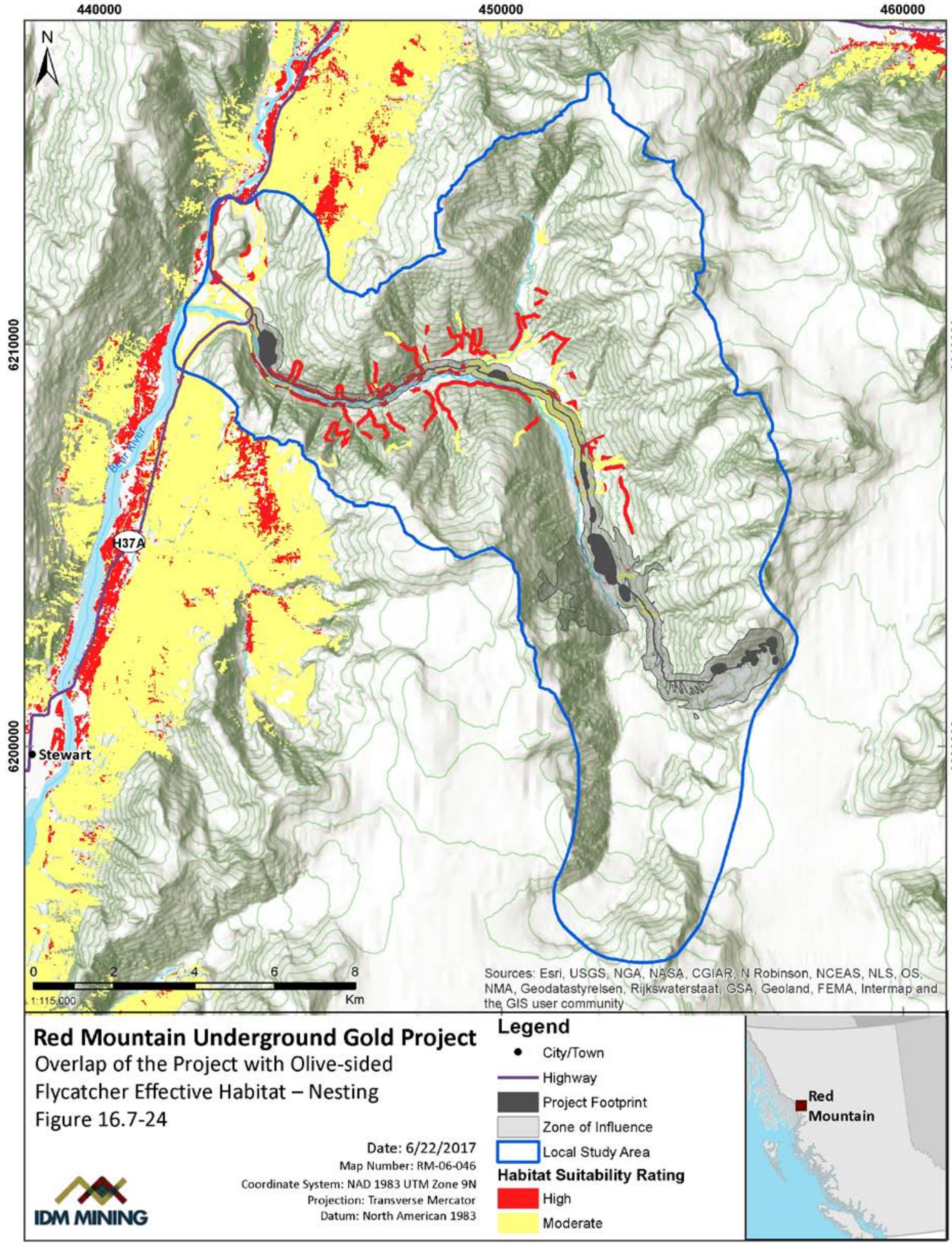
Not Significant. The combined residual effects of habitat alteration and sensory disturbance are not significant based on the low magnitude, the long-term duration, and regular occurrence. Habitat alteration and sensory disturbance will result in a greater than negligible adverse effect within the LSA, but the effect is considered reversible, and it is unlikely that these effects would pose a risk to the long-term persistence and viability of olive-sided flycatcher at the regional level (i.e., RSA).

Confidence and Risk

Moderate. The cause-effect relationships between the Project and olive-sided flycatcher are not fully understood. Baseline surveys for olive-sided flycatcher were conducted in the LSA within general breeding bird surveys. Habitat preferences of olive-sided flycatcher are well understood, the habitat was modelled across the RSA, and modeled suitability ratings correlated well with field observations.

The primary uncertainty associated with this prediction is the degree to which olive-sided flycatcher are actually displaced by mining operations within the sensory disturbance zones resulting in reduced habitat. The assumptions used in this assessment are precautionary, both in terms of the sizes of the disturbance ZOIs and magnitude of effect (i.e., complete loss of habitat), and likely overestimate potential Project effects on habitat availability. There is very low risk that the Project effects could exceed those used in this assessment. More likely, olive-sided flycatcher will continue to some use portions of the sensory disturbance ZOIs and the effects will be less than those used in this assessment.

Figure 16.7-24: Overlap of the Project with Olive-sided Flycatcher Effective Habitat — Nesting



16.7.11 Potential Residual Effects Assessment — Raptors

This section describes the nature of Project-related potential residual effects identified with respect to raptors, which includes the northern goshawk *laingi* subspecies and the western screech-owl *kennicottii* subspecies.

The potential residual effects of the Project on raptors are addressed by a combination of mitigation measures as described in Section 16.6 and in the WMP (Volume 5, Chapter 29). Mitigation measures that will minimize potential effects include Project design measures, minimizing habitat disturbance, avoiding disturbance during the breeding season, conducting pre-clearing nest surveys during the breeding season if disturbance cannot be avoided, managing vehicle traffic (e.g., speed limits), preventing wildlife entrapment in Project infrastructure, and managing chemical hazards and attractants. Following the successful implementation of the mitigation measures described in Section 16.6 and the WMP, mortality risk through direct morality, indirect mortality, chemical hazards, and attractants are not expected to be residual effects. The potential residual effect on raptors is habitat availability (including habitat alteration and sensory disturbance).

The main sources of mortality risk for raptors includes: i) incidental take during vegetation clearing and ground disturbance and ii) collisions and electrocution caused by the Powerline. The possibility for increased mortality risk for western screech-owl as a result of the Project is very low given the limited suitable habitat in the RSA and the lack of evidence of their presence in the RSA. If western screech-owl were to occur, there are likely only a few individuals. For raptors in general, mortality risk is expected to be effectively mitigated through multiple mitigation measures (see Table 16.6-1), such as the identification and buffering of raptor nests and habitat features. Direct mortality related to collisions with vehicles and the Powerline is a possibility and will be reduced by standard vehicle mitigation (e.g. traffic limitations and speed reduction), Project design, and best practices related to transmission lines (see WMP Volume 5, Chapter 29). Collisions and electrocution are identified as minor potential threats or limiting factors in the COSEWIC Assessment and Status Report (2012b). Based on review of their main threats, application of mitigation measures, and consideration of traffic volumes in this assessment (see discussion in Section 16.7.10.2.2), mortality risk is not a potential residual effect for raptors.

The northern goshawk *laingi* subspecies habitat models for coastal BC include a nesting habitat model, a foraging habitat model, and a "territory" model (Mahon et al. 2015). The territory model outputs should not be used at scales less than 500,000 ha because the outputs are too coarse an indicator for use at smaller scales (Mahon et al. 2015). This is because some of the forest cover data has relatively poor stand level accuracy and some variables important to goshawk habitat suitability (e.g., canopy cover) are not available in the forest cover data across the study area (Mahon et al. 2015). When evaluating goshawk habitat at scales less than 500,000 ha, such as within the Project RSA, it is recommended to focus on outputs only from the nesting and foraging habitat models (Mahon et al. 2015).

The estimated territory size for goshawks in the North Coast region is approximately 9,200 ha (Mahon et al. 2015). The Project RSA is 205,350 ha in size; therefore, the Project only has the potential to affect a small number of territories. At the Project LSA level, both effective nesting and foraging habitat (i.e., habitat rated as moderate or high suitability) are largely constrained to the CWH BGC zone, which occurs in valley bottoms to lower slopes along Bitter Creek and around Clements Lake. The potential effect of the Project where it interacts with goshawk habitat is limited to the Access Road, and such small forest openings are not anticipated to have any negative effects on habitat fragmentation or movement. Therefore, habitat distribution is not considered a residual effect for the northern goshawk *laingi* subspecies.

16.7.11.1 Northern Goshawk

16.7.11.1.1 Habitat Availability

Habitat availability for the northern goshawk *laingi* subspecies includes changes to the amount or quality of effective nesting or foraging habitat (i.e., habitat rated as high or moderate suitability) as a result of habitat alteration or sensory disturbance. Habitat alteration was assessed quantitatively within the RSA by calculating how much effective nesting or foraging habitat overlapped with the Project footprint. Sensory disturbance was assessed quantitatively within the RSA by calculating how much effective nesting or foraging habitat overlapped with a 500 m ZOI around the Project (justification described in Table 16.3-5). For nesting habitat, all high and moderate WHRs within the ZOI were downgraded to a minimum of low; low habitat ratings remained low and nil habitat ratings remained nil. For foraging habitat, all WHRs within the ZOI were downgraded by one class to a minimum of low (i.e., high becomes moderate; moderate becomes low; low stays low; and nil remains nil). For foraging habitat, the 500 m ZOI was only applied to the Process Plant and infrastructure and did not include the Access Road. The resulting habitat values were then summarized and compared to the available effective nesting habitat within the RSA.

The LSA contains 743 ha of effective nesting habitat and 2,574 ha of effective foraging habitat for northern goshawk (Table 16.7-17; Figure 16.7-25; Figure 16.7-26). These habitats are largely constrained to the CWH BGC zone, which occurs in valley bottoms to lower slope macro positions along Bitter Creek and around Clements Lake. Vegetation clearing and ground disturbance within areas of effective nesting and foraging habitat that overlap with the Access Road and Process Plant will likely have an adverse effect on northern goshawks. The habitat assessment indicated that 221 ha of effective nesting habitat may be adversely affected due to habitat alteration and sensory disturbance. This represents 3% of effective nesting habitat within the RSA. The habitat assessment also indicated that 399 ha of effective foraging habitat may be adversely affected due to habitat alteration and sensory disturbance (Table 16.7-17). This represents 2% of effective foraging habitat within the RSA.

Table 16.7-17: Summary of Change in Habitat Availability — Northern Goshawk

Habitat Type	Area of Altered Habitat (ha)	Area of Sensory Disturbance (ha)	Total Habitat Change (ha)	LSA – Total Habitat (ha)	LSA – Habitat Change (%)	RSA – Total Habitat (ha)	RSA– Habitat Change (%)
Nesting	12	209	221	743	30	6,692	3
Foraging	39	360	399	2,574	16	16,743	2

Characterization of Residual Effect

The Project is expected to have an adverse effect on effective nesting and foraging habitat for the northern goshawk *laingi* subspecies due to habitat alteration and sensory disturbance. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The combined effects are considered to have a moderate magnitude within the RSA because approximately 6% of effective nesting and foraging habitat will be directly or indirectly affected by the combined Project footprint and 500 m ZOI. The geographic extent of the combined effects is expected to be local and entirely limited to the LSA. Habitat alteration and sensory disturbance are expected to be long-term in duration with effects occurring from the Construction Phase to the Closure and Reclamation Phase. The effects of habitat alteration and sensory disturbance will be continuous throughout the Project but are considered reversible once mining activities cease and reclamation occurs.

Context is considered low because the northern goshawk *laingi* subspecies is a species at risk in BC and Canada that is sensitive to large-scale habitat changes (COSEWIC 2013b) and disturbances around its nest sites (BC MOE 2013a). The main threat to the *laingi* subspecies is forest harvesting that reduces and fragments nesting and foraging habitat, adversely affecting the availability of suitable nest sites and the abundance and diversity of prey (NGRT 2008; FLNRO 2013; COSEWIC 2013b). In addition, goshawks typically rear only one brood per season, and clutch size is relatively small (i.e., average two to four eggs) with only two to three fledglings per successful nest (Squires and Reynolds 1997). Therefore, the *laingi* subspecies may not be able to respond and adapt to adverse habitat effects as readily as other raptors.

Likelihood

High. The combined Project footprint and 500 m ZOI overlap with effective nesting and foraging habitat for this subspecies. Two goshawks were also detected within the LSA during baseline field surveys in 2014 and 2016; these detections corresponded with suitable nesting and foraging habitat for goshawks.

Significance

Not Significant. The combined residual effects of habitat alteration and sensory disturbance are assessed to be not significant for the northern goshawk *laingi* subspecies based on moderate magnitude and local geographic extent. Although habitat alteration and sensory disturbance may result in a greater than negligible adverse effect within the LSA, it is unlikely that these effects would pose a risk to the long-term persistence and viability of the *laingi* subspecies at the regional level (i.e., RSA).

Confidence and Risk

Moderate. Habitat preferences of northern goshawk are well known and several habitat models based on current knowledge were used to determine the assessment. There is a reasonable but not full understanding of the cause-effect relationship between habitat alteration and the persistence of the species at the population level. The effectiveness of mitigation measures is considered moderate for habitat alteration and minimizing sensory disturbance. The Project footprint will be minimized and existing infrastructure and roads will be used to the greatest extent practicable, which will minimize habitat alteration for goshawks. Vegetation clearing and ground disturbance will also be avoided during the nesting season whenever possible.

The assumptions used in this assessment are precautionary, both in terms of the sizes of the disturbance ZOIs and magnitude of effect (i.e., complete loss of habitat), and likely overestimate potential Project effects on habitat availability. There is very low risk that the Project effects could exceed those used in this assessment. More likely, northern goshawk *laingi* will continue to some use portions of the sensory disturbance ZOIs and the effects will be less than those used in this assessment.

Figure 16.7-25: Overlap of the Project with Northern Goshawk Effective Habitat — Nesting

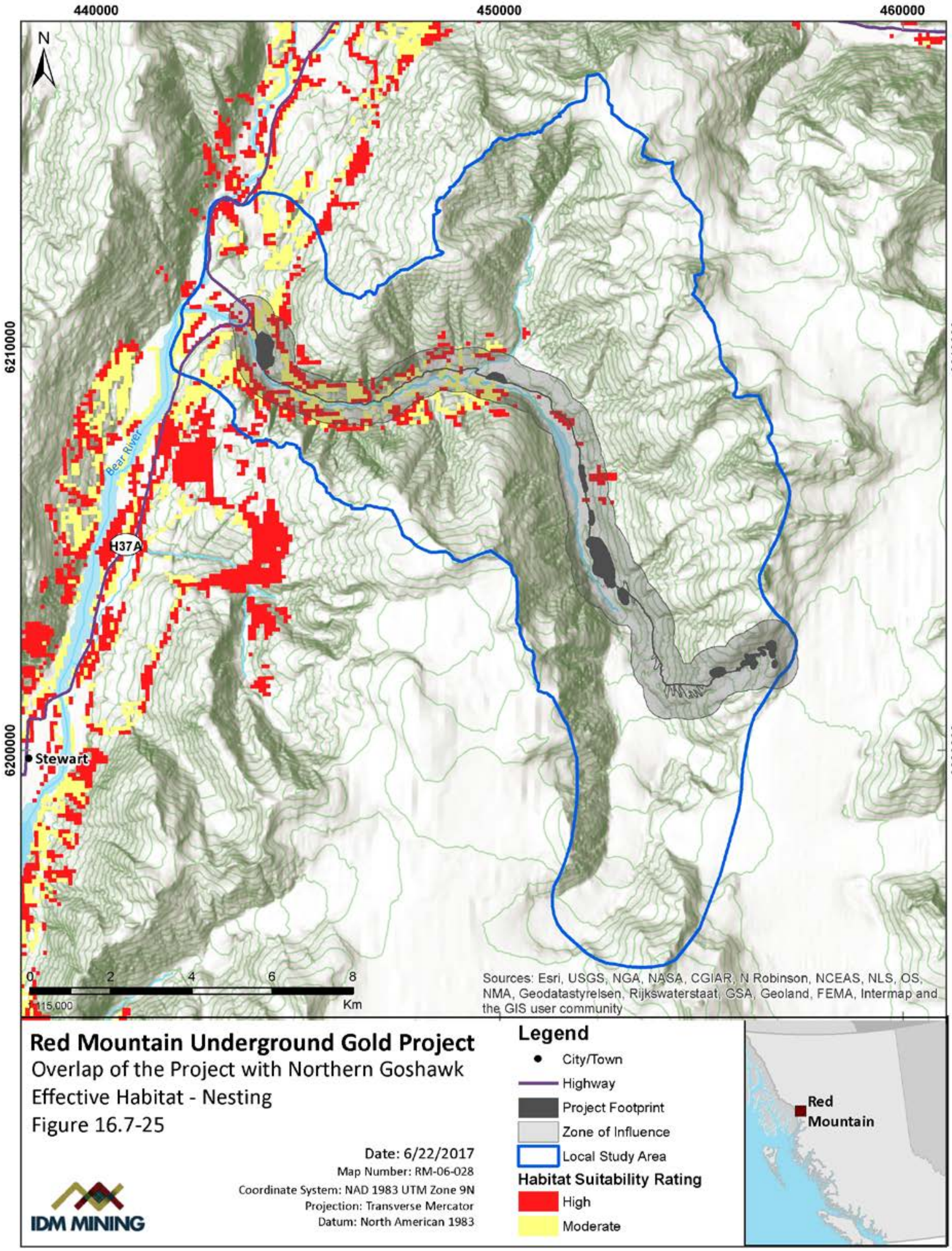
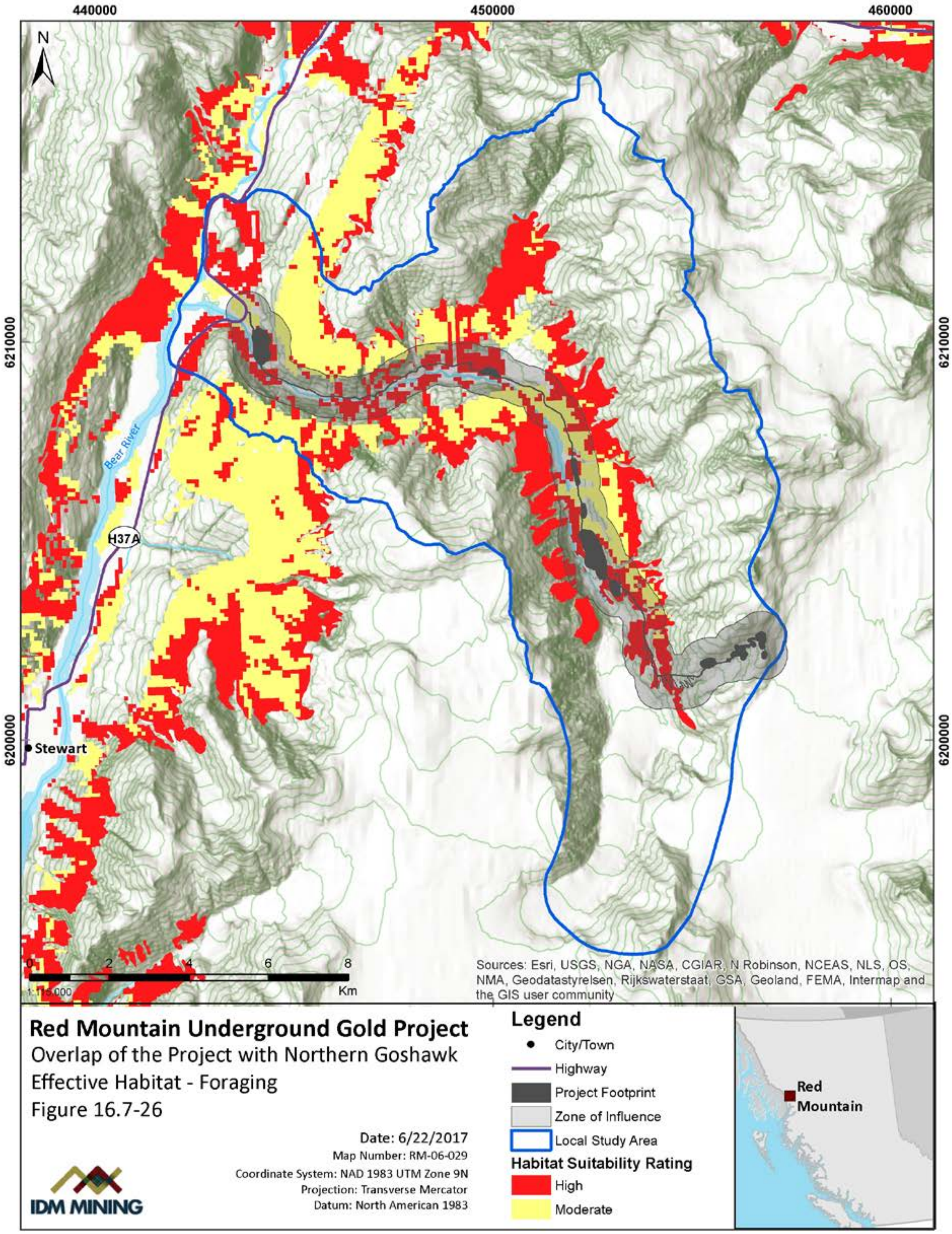


Figure 16.7-26: Overlap of the Project with Northern Goshawk Effective Habitat — Foraging



16.7.11.2 Western Screech-owl

16.7.11.2.1 Habitat Availability

Habitat availability includes habitat alteration and sensory disturbance. Habitat alteration was assessed quantitatively for western screech-owl by calculating the amount of effective nesting habitat (i.e., habitat rated as high or moderate suitability) that overlapped with the Project footprint. Sensory disturbance was assessed quantitatively by calculating the area of effective nesting habitat that overlapped within a 300 m ZOI around the Project footprint (rationale in Table 16.3-5).

The LSA contains approximately 71 ha and the RSA contains approximately 4,127 ha of effective nesting habitat for western screech-owl (Table 16.7-18; Figure 16.7-27). In the LSA, this habitat is located at lower elevations along Bitter Creek between the confluences with the Bear River and Roosevelt Creek. Approximately 3 ha of effective nesting habitat (representing less than 1% of the effective habitat in the RSA) will be altered by the Project footprint. The change to habitat availability due to sensory disturbance was quantified by downgrading the high quality habitat that occurred within the ZOI to moderate quality habitat, and moderate quality habitat to low quality habitat.

Table 16.7-18: Summary of Change in Habitat Availability — Western Screech-owl

Habitat Type	Area of Altered Habitat (ha)	Area of Sensory Disturbance (ha)	Total Habitat Change (ha)	LSA – Total Habitat (ha)	LSA – Habitat Change (%)	RSA – Total Habitat (ha)	RSA– Habitat Change (%)
Nesting	3	0	3	71	4	4,127	<1

Characterization of Residual Effect

The Project is expected to have an adverse effect on western screech-owl nesting habitat due to reduced habitat availability. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The effect is low magnitude because less than 1% of effective nesting habitat within the RSA will be directly or indirectly affected by the combined Project footprint and a 300 m ZOI. The geographic extent of the effect is expected to be local and limited to within the LSA. Habitat alteration and sensory disturbance are expected to be long-term in duration with effects occurring from the Construction Phase to the Closure and Reclamation Phase. The effects of habitat alteration and sensory disturbance will be continuous throughout the Project but are considered reversible once mining activities cease and reclamation occurs. The context is considered low because the western screech-owl is a species at risk in BC (Blue-listed) and Canada (Threatened), and habitat loss is identified as a potential threat (COSEWIC 2012b, BC MOE 2013b).

Likelihood

High. The Project footprint overlaps with potential nesting habitat for this species. The likelihood that sensory disturbance effects to owls within a 300 m ZOI is low because to date no owls have been detected within the RSA, and the habitat occurs in small patches that are unlikely to support breeding pairs. It is likely an effect will occur and that the precautionary approach on the ZOI overestimates the magnitude of the effect.

Significance

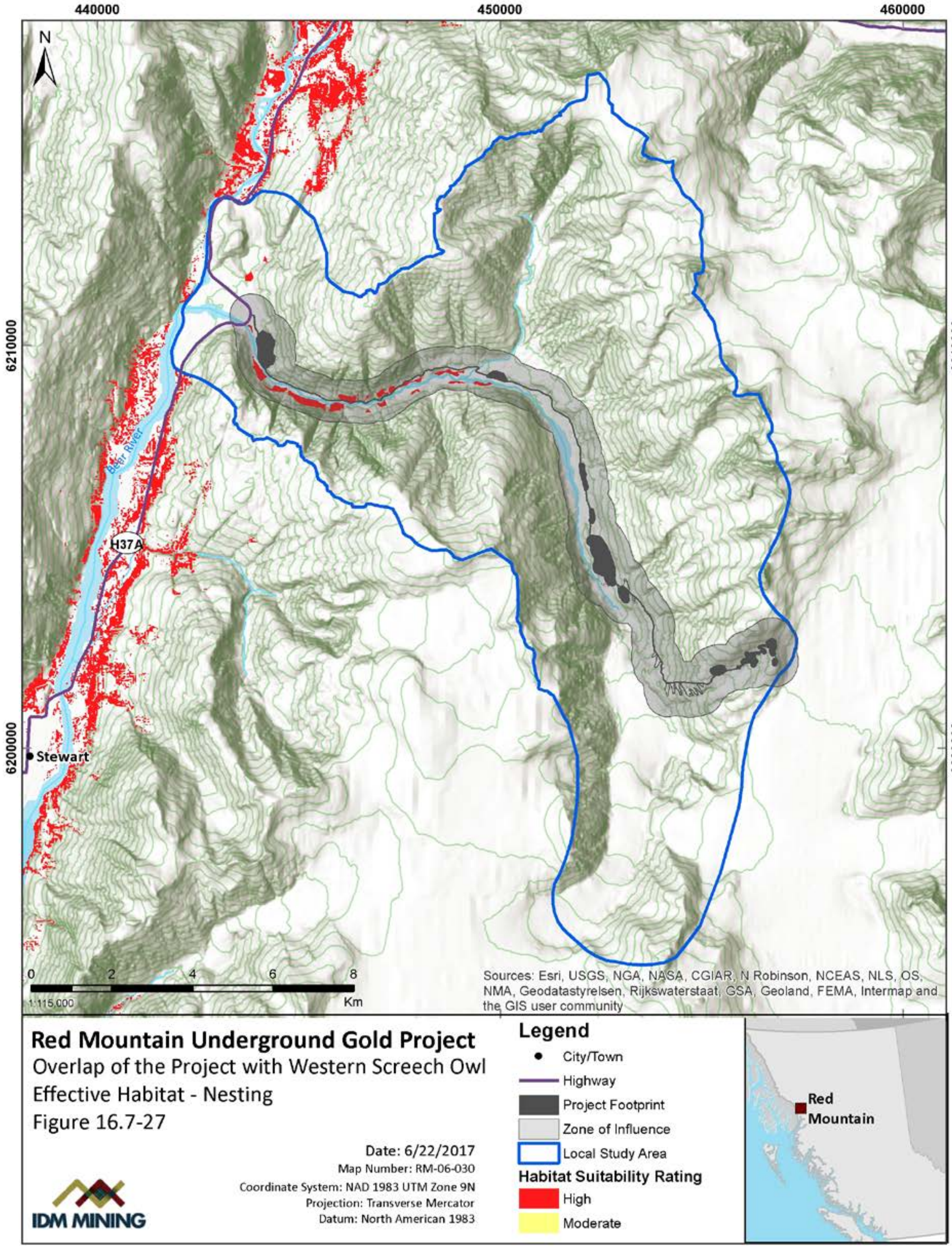
Not Significant. The effect of habitat alteration is not significant based on low magnitude and local geographic extent. Although habitat alteration may result in a greater than negligible adverse effect within the LSA, it is unlikely that these effects would pose a risk to the long-term persistence and viability of western screech-owl if they were to occur in the RSA. There have been no western screech-owl detections in the RSA.

Confidence and Risk

Moderate. The cause-effect relationships between the Project habitat effects and owls are not fully understood, and population-level effects at broader geographic scale (e.g., broad-scale loss of large trees/snags with cavities), combined with other threats such as the spreading occurrence of barred owls and resulting predation may mask any effect that this Project could have on individual western screech-owl. The primary uncertainty is in how far habitat effects from sensory will extend beyond the Project footprint. The 300 m ZOI around the Project infrastructure likely overestimates potential Project effects on habitat availability.

The effectiveness of mitigation measures is considered moderate for habitat alteration and sensory disturbance. The Project footprint will be minimized and existing roads will be used to the greatest extent practicable, which will minimize habitat alteration for western screech-owl. Vegetation clearing and ground disturbance will also be avoided during the nesting season whenever possible.

Figure 16.7-27: Overlap of the Project with Western Screech-owl Effective Habitat — Nesting



16.7.12 Potential Residual Effects Assessment — Non-migratory Game Birds

Migratory game birds were assessed for potential Project-related residual effects to habitat availability (including habitat alteration and sensory disturbance) and to mortality risk through direct mortality. Following implementation of effective mitigation measures in conjunction with consideration of habitat preferences, indirect mortality, chemical hazards, and attractants were not considered potential residual effects (see Table 16.6-1).

Attractants and chemical hazards may be present at the active Mine Site; however, game birds are unlikely to be attracted to these as they prefer herbaceous forage. In addition, IDM will implement mitigation measures such as appropriate storage and handling of potential attractants and chemical hazards along with development and implementation of the Wildlife Education Program and wildlife protection protocols (see Section 16.6.1 for additional mitigation details) to avoid or minimize these effects.

Indirect mortality as a result of increased hunting pressure, increased predation, and physical entrapment within Project infrastructure is not expected to occur. Mitigations to limit hunting-related mortality will include access control on the Access Road near Highway 37A and a no firearms, no hunting policy for employees and contractors within the LSA. The potential effect is expected to be negligible.

Sediment ponds and other infrastructure may pose entrapment hazards for game birds; however, wildlife exclusion measures are expected to effectively mitigate these potential effects.

16.7.12.1 Sooty Grouse

16.7.12.1.1 Habitat Availability

Habitat availability includes changes to the amount of effective habitat as a result of habitat alteration or sensory disturbance. Habitat alteration was assessed quantitatively for sooty grouse within the context of the RSA. Altered habitat was calculated as the effective habitat (high and moderate quality) that overlapped with the Project footprint. The ZOI for sooty grouse was defined as any area within 300 m of the Project footprint plus any habitat within the 45 dBA sound isopleth for operational noise (see Table 16.3-5 for rationale). Sensory disturbance was assessed by downgrading high and moderate quality habitat located within the ZOI by one habitat class (i.e., high becomes moderate and moderate becomes low).

There are 3,734 ha of effective sooty grouse nesting habitat within the LSA; this represents 24% of the total area in the LSA (Table 16.7-19; Figure 16.7-28). Effective nesting habitat for sooty grouse is found in the subalpine and alpine portions of the LSA. Most of this effective habitat that could be directly affected by Project infrastructure is located around the Haul Road, the Process Plant, and TMF. There are also isolated patches of nesting habitat along the Haul Road.

There are 1,959 ha of effective winter living habitat within the LSA; this represents 12% of the total area of the LSA (Table 16.7-19; Figure 16.7-29). Winter living habitat is most prevalent in the lower portion of the Bitter Creek valley, along the first 8 km of the Access

Road (below the borrow pit). There are some isolated areas of winter living habitat along the upper portion of the Access Road. There is no winter living habitat located in the alpine areas of the LSA, above the TMF.

Residual Effect Analysis

The Project footprint will have direct effects on 77 ha of effective nesting habitat (Table 16.7-19). An additional 176 ha of effective nesting habitat will be subject to sensory disturbance from the Project. In total, 253 ha of effective nesting habitat will be influenced by direct Project effects or sensory disturbance; this represents less than 1% of the effective nesting habitat within the RSA.

The Project footprint will have direct effects on 30 ha of effective winter living habitat (Table 16.7-19). An additional 118 ha of effective winter living habitat will be subject to sensory disturbance from the Project. In total, 148 ha of effective winter living habitat will be influenced by direct Project effects or sensory disturbance; this represents 1% of the effective winter living habitat within the RSA.

Table 16.7-19: Summary of Change in Habitat Availability — Sooty Grouse

Habitat Type	Area of Altered Habitat (ha)	Area of Sensory Disturbance (ha)	Total Habitat Change (ha)	LSA – Total Habitat (ha)	LSA – Habitat Change (%)	RSA – Total Habitat (ha)	RSA– Habitat Change (%)
Nesting	77	176	253	3,734	7	47,151	<1
Winter Living	30	118	148	1,959	8	19,433	<1

Characterization of Residual Effect

The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. Project effects on habitat availability have a low magnitude rating because total Project effects will affect approximately 1% of the effective habitat within the RSA for both nesting and winter living habitats. The geographical extent of habitat effects is local, because effects will be limited to areas around the Project footprint. The duration of Project effects on habitat availability will be long-term. Altered habitat within the Project footprint, 77 ha of nesting habitat and 30 ha of winter living habitat, will remain altered beyond the Closure and Reclamation Phase of the Project as it can take many years for vegetation to recover following disturbance. The area affected by sensory disturbance, 176 ha of nesting habitat and 118 ha of winter living habitat, should return to the original habitat effectiveness following the Project Closure and Reclamation Phase. Effects on habitat availability are considered reversible, as most effected habitat will recover once sensory disturbance ceases, and remaining altered habitat will eventually recover following site reclamation. The effects of habitat alteration and sensory disturbance will be continuous throughout the Project.

Sooty grouse populations can increase dramatically following fire and timber harvest (Zwickel and Bendell 2005); therefore, grouse are expected to occupy habitat affected by the Project area soon after Project Closure and Reclamation Phase. For these reasons, sooty grouse are considered resilient to changes in habitat availability and context was rated high for this VC.

Likelihood

High. The Project footprint will overlap with effective summer and winter habitat.

Significance

Not Significant. Project effects on habitat availability are considered not significant because any residual effect will have a low magnitude, a local extent, and be reversible. Sooty grouse populations are also considered to have high resilience to changes in habitat availability. Based on these criteria it is unlikely that the Project will have a measurable effect on the size or viability of the sooty grouse population within the RSA.

Confidence and Risk

High. There is a good understanding of the cause-effect relationship between the Project and sooty grouse habitat availability. The primary uncertainty is in how far habitat effects from sensory will extend beyond the Project footprint. The 300 m ZOI around Project components, plus any predicted effects of Project noise beyond 300 m, likely overestimates potential Project effects on habitat availability. There is very low risk that the Project effects could exceed those used in this assessment.

Figure 16.7-28: Overlap of the Project with Sooty Grouse Effective Habitat — Summer Living

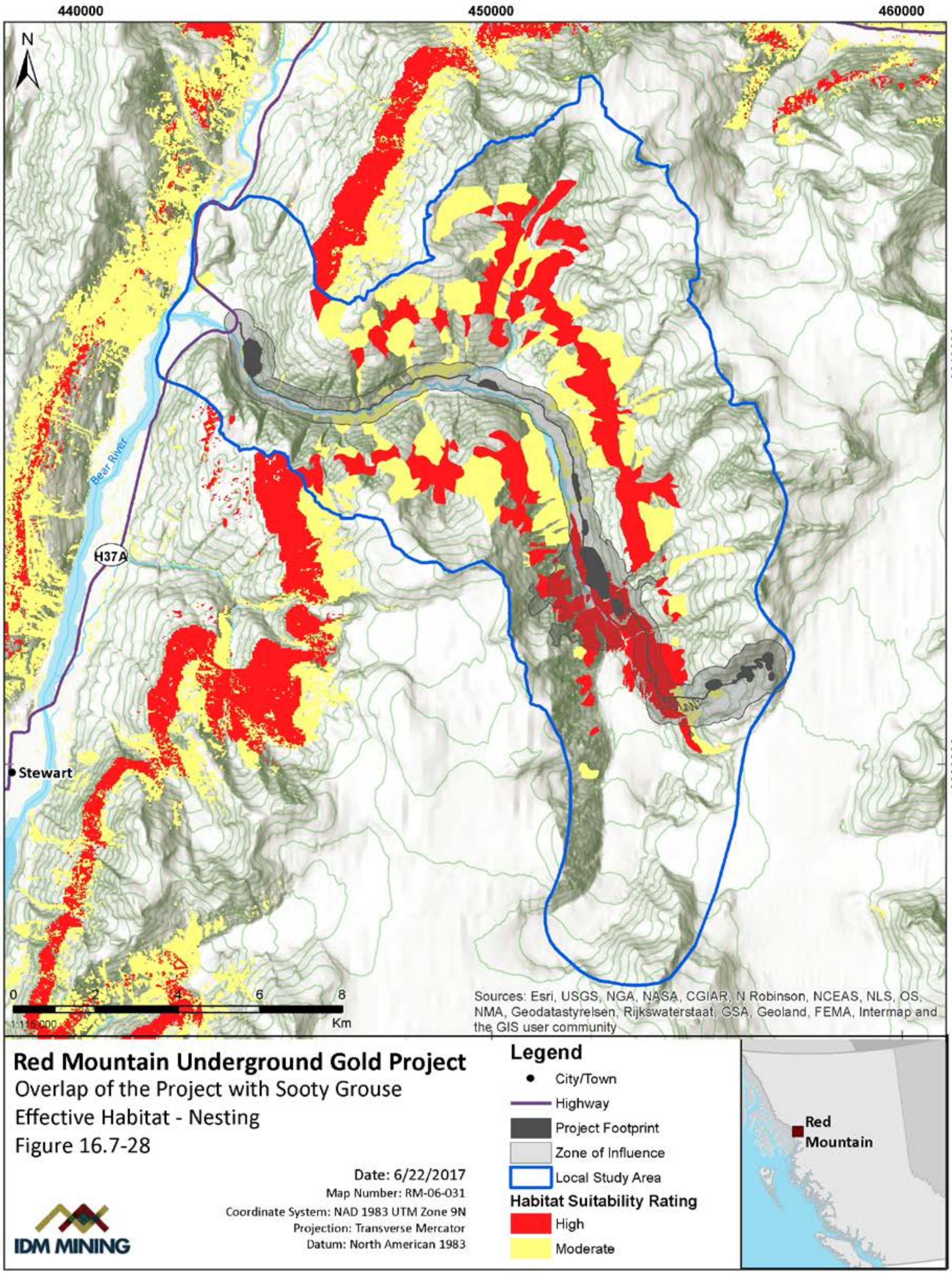
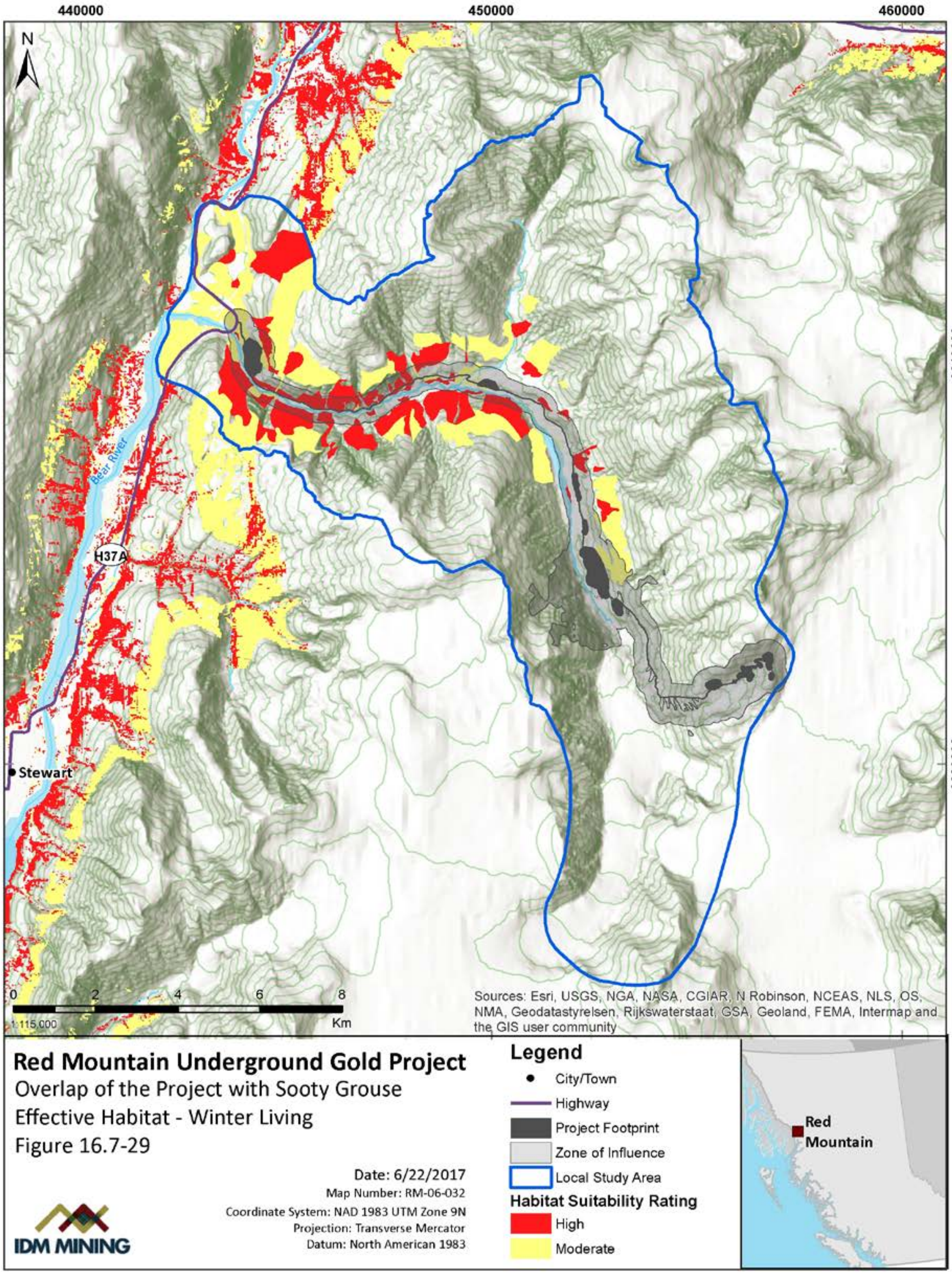


Figure 16.7-29: Overlap of the Project with Sooty Grouse Effective Habitat — Winter Living



16.7.12.1.2 Mortality Risk

Mortality risk includes changes to non-migratory game bird mortality via direct and indirect pathways. Direct mortality pathways for non-migratory game birds include incidental take during vegetation clearing and ground disturbance activities, collisions with Project-related traffic on the Mine Site and Access Road, or collisions and electrocution caused by the Powerline. Mitigation measures to minimize traffic volumes and limit vehicle speeds on Project roads are expected to be highly effective; therefore, vehicle collisions were not included in this effects assessment.

Direct mortality risk due to incidental take was assessed qualitatively within the context of the RSA by identifying important habitat areas and features from baseline studies and habitat modelling and assessing them in the context of the proposed Project footprint and vegetation clearing/ground disturbance schedule.

Direct mortality risk due to collisions with Project components was assessed using a combination of qualitative and quantitative methods. Collisions with high tension power lines can be an important source of mortality for grouse (Catt et al. 1994; Bevanger 1995). Research from Norway estimates that black grouse, a species with similar habitat requirements and size as sooty grouse, collide with powerlines at a rate of 0.495 mortalities/km/year, after accounting for search bias, with all recorded collisions occurring during the non-breeding season (Sept to May; Bevanger 1995). This estimate was used to calculate the expected number of collision related deaths annually based on the length of transmission line (km) that will run through winter sooty grouse habitat.

Residual Effect Analysis

In BC, sooty grouse breed between the last week of April and the end of August (Starzomski 2015). To avoid incidental mortality of adults, chicks, or eggs, vegetation clearing or ground disturbance will be avoided within grouse nesting habitat during the breeding season. If clearing must occur during this sensitive period, then pre-clearing nest surveys will be conducted to minimize potential for incidental take of grouse.

There are 14 km of Powerline that overlap with winter habitat of sooty grouse. Using an estimated collision rate of 0.495 collisions/km/year (Bevanger 1995); there could be eight mortalities of sooty grouse associated with the Powerline per year. Over the life of the Project, this would result in a total mortality estimate of 64 sooty grouse resulting from the Powerline. The daily aggregate bag limit for sooty grouse is 10 and the aggregate possession limit is 30 within the Skeena hunting region (FLNRO 2016b). Therefore expected annual Powerline mortality associated with the Project would be less than one additional hunter meeting the daily bag limit or the total yearly limit. Based on records of licensed hunters and harvest in the RSA (MU 6-14 and MU 6-16; data provided by FLNRO; K. Dixon pers. comm. 2017) there were on average 561 resident hunter days per year between 2005 and 2015. Between 1976 and 2015, a total of 559 sooty grouse (blue grouse) were harvested and between 1976 and 2015, a total of 6,366 ruffed grouse were harvested within the same area. Given this context on the level of regulated hunting that occurs and is allowed, the possible mortality of eight sooty grouse per year would fall within the amount the wildlife management allocation considers acceptable without apparent detriment to the population over the past decades in the RSA.

Mitigation measures to make transmission lines more visible to flying birds could further reduce mortality risk (Rioux et al. 2013).

Characterization of Residual Effect

The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The magnitude of effects on direct mortality was considered low because most potential sources of mortality could be effectively mitigated, and estimates of Powerline collisions were less than 10 mortalities per year. Residual effects of mortality are considered local because any mortality would occur within the Project boundaries and could influence population density within the LSA. The duration is long-term because mortalities could occur any time within the Construction, Operation Phase, and Closure and Reclamation Phase. Frequency of this effect is sporadic, as mortalities are expected to be rare, with the highest risk during most spring and fall migration (Zwickel and Bendell 2005). Effects of mortality were considered reversible at the population level, because high reproductive rates and immigration can compensate for mortalities (Zwickel and Bendell 2005).

Sooty grouse population densities can increase dramatically following logging or natural disturbances (Zwickel and Bendell 2005) and rapidly repopulate breeding areas following experimental removal (Zwickel 1972; Bendell et al. 1972); therefore this species is expected to be resilient to any mortality effects from the Project.

Likelihood

Moderate. It is expected that the mitigation measures outlined in Section 16.6 will be effective in reducing direct mortality risk for non-migratory game birds, but there is still a small probability that some mortalities will still occur during the life of the Project.

Significance

Not Significant. There are likely to be residual effects of direct mortality on sooty grouse; however, these effects are assessed as not significant because they are low in magnitude, local in extent, reversible, and sooty grouse resiliency was rated as high.

Confidence and Risk

Moderate. There is specific information available on the mortality associated with collisions for sooty grouse that supports the assessment and the cause-effect relationship between the Project and sooty grouse. The confidence is moderated as the effectiveness of mitigation measures for direct mortalities is moderate and the applicability of the supporting data is also moderate. The models used to estimate Powerline-related mortalities are based on a similar species in similar habitat, but this may not accurately reflect mortality risk for sooty grouse in the LSA.

16.7.12.2 White-tailed Ptarmigan

16.7.12.2.1 Habitat Availability

Habitat availability includes changes to the amount or quality of available habitat as a result of habitat alteration or sensory disturbance. Habitat alteration was assessed quantitatively for white-tailed ptarmigan within the context of the RSA. Altered habitat was calculated as the effective living habitat (high and moderate quality) that overlapped with the Project footprint. The ZOI for white-tailed ptarmigan was defined as any area within 300 m of the Project footprint plus any habitat within the 45 dBA sound isopleth for operational noise (see Table 16.3-5 for rationale). Sensory disturbance was assessed by downgrading high and moderate quality habitat located within the ZOI by one habitat class (i.e., high becomes moderate and moderate becomes low). Since habitat requirements for nesting and winter living were similar only one model (winter living) was developed for this species.

Residual Effect Analysis

There are 2,868 ha of effective winter living habitat within the LSA and 46,268 ha of effective winter living habitat within the RSA (Table 16.7-20; Figure 16.7-30). Effective white-tailed ptarmigan winter living habitat is mainly in alpine areas of the LSA and a small amount of effective habitat overlaps the Project footprint along the lower portion of the Haul Road.

The Project footprint will have direct effect on 11 ha of effective winter living habitat. An additional 242 ha of effective winter living habitat would be subject to sensory disturbance from the Project. In total, 253 ha of effective habitat will be influenced by direct Project effects or sensory disturbance; this represents less than 1% decline in the total effective habitat within the RSA.

Table 16.7-20: Summary of Change in Habitat Availability — White-tailed Ptarmigan

Habitat Type	Area of Altered Habitat (ha)	Area of Sensory Disturbance (ha)	Total Habitat Change (ha)	LSA – Total Habitat (ha)	LSA – Habitat Change (%)	RSA – Total Habitat (ha)	RSA– Habitat Change (%)
Winter Living	11	242	253	2,868	9	46,268	<1

Characterization of Residual Effect

The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. Project effects on habitat availability have a low magnitude rating because less than 1% of the effective habitat within the RSA will be affected by habitat alteration or sensory disturbance. The geographical extent of habitat effects is local, because effects will be limited to areas around the Project footprint. The duration of Project effects on habitat availability will be long-term. Altered habitat within the Project footprint, 11 ha, will remain altered beyond the life of the Project as it can take many years for alpine vegetation to recover following disturbance. The area affected by sensory disturbance, 242 ha, should return to the original habitat effectiveness following the Project Closure and Reclamation Phase. Effects on habitat availability are considered reversible, as most effected habitat will recover once sensory disturbance ceases, and remaining altered habitat will eventually recover following site reclamation. The effects of habitat alteration and sensory disturbance will be continuous throughout the Project but are considered reversible once mining activities cease and reclamation occurs.

White-tailed ptarmigan populations are well adapted to stochastic environments and populations are known to persist even with regular low densities, poor survival, and low fecundity (Martin et al. 2015). Populations or ptarmigan are also known to avoid local extinction through immigration following episodes of low reproduction or survival (Martin et al. 2015). For these reasons, ptarmigan are considered resilient to changes in habitat availability and context was rated high for this VC.

Likelihood

High. The Project footprint will overlap with high and moderate quality habitat.

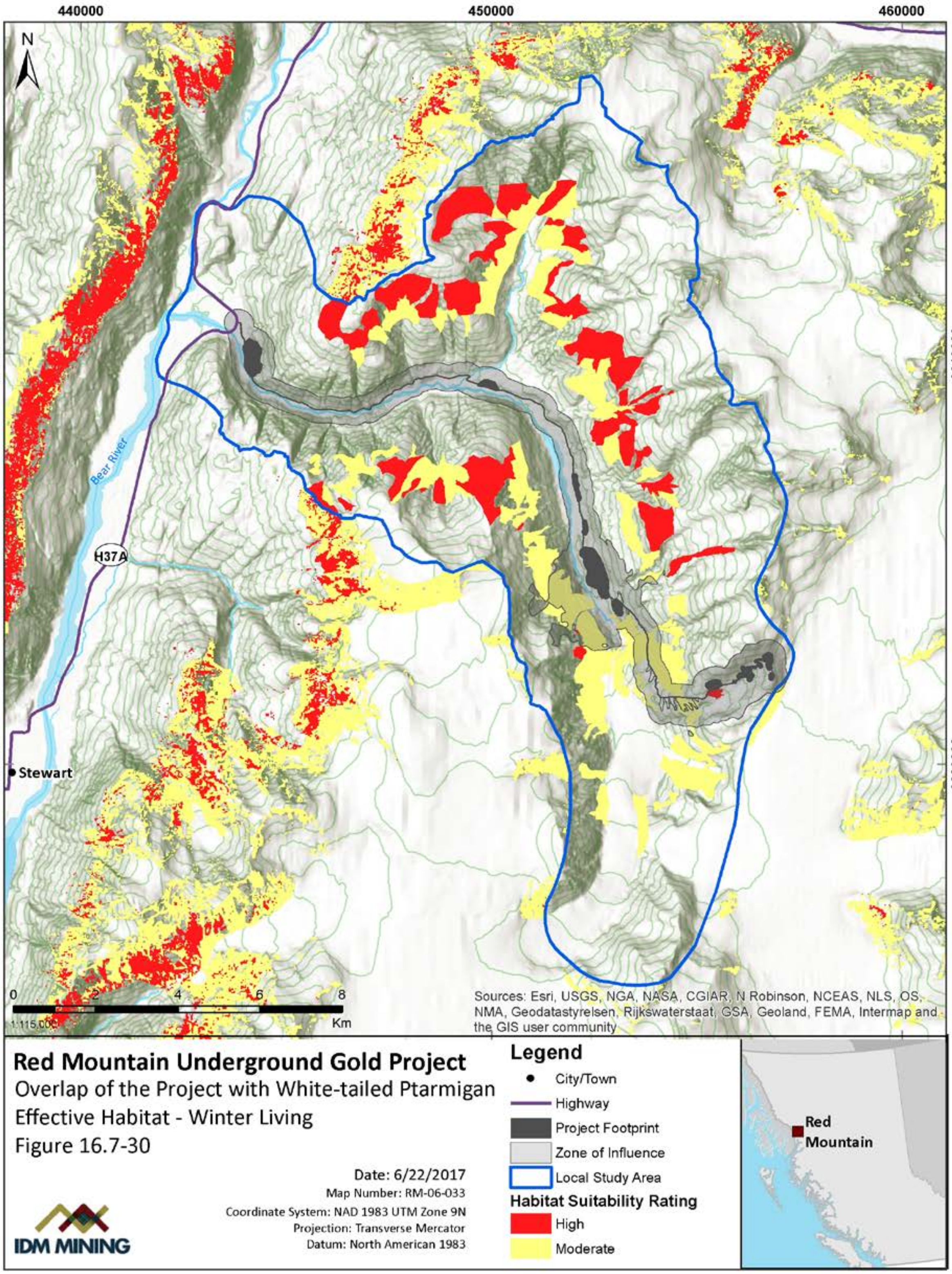
Significance

Not Significant. Project effects on habitat availability for white-tailed ptarmigan are considered not significant because any residual effect will have a low magnitude, a local extent, and be reversible. White-tailed ptarmigan populations are also considered to have high resilience to changes in habitat availability. Based on these criteria it is unlikely that the project will have a measurable effect on the size or viability of the white-tailed ptarmigan population within the RSA.

Confidence and Risk

High. There is a good understanding of the cause-effect relationship between the Project and White-tailed ptarmigan availability. The primary uncertainty is in how far habitat effects from sensory will extend beyond the Project footprint. The 300 m ZOI around the Project components, plus any predicted effects of Project noise beyond 300 m, likely overestimates potential Project effects on habitat availability. There is very low risk that the Project effects could exceed those used in this assessment.

Figure 16.7-30: Overlap of the Project with White-tailed Ptarmigan Effective Habitat — Winter Living



16.7.12.2.2 Mortality Risk

Mortality risk includes changes to non-migratory game bird mortality via direct and indirect pathways. Direct mortality pathways for non-migratory game birds include incidental take during vegetation clearing and ground disturbance activities, collisions with Project-related traffic on the Mine Site and Access Road, or collisions and electrocution caused by the Powerline. Mitigation measures to minimize traffic volumes and limit vehicle speeds on Project roads are expected to be highly effective; therefore, vehicle collisions were not included in this effects assessment

Direct mortality risk due to incidental take was assessed qualitatively within the context of the RSA by identifying important habitat areas and features from baseline studies and habitat modelling and assessing them in the context of the proposed Project footprint and vegetation clearing/ground disturbance schedule.

Direct mortality risk due to collisions with project infrastructure was assessed quantitatively. Collisions with high tension power lines can be a significant source of mortality for grouse (Catt et al. 1994; Bevanger 1995). Research from Norway estimates that willow ptarmigan, a species with similar habitat requirements and size as white-tailed ptarmigan, collide with powerlines at a rate of 3.4 mortalities/km/year, after accounting for search bias (Bevanger 1995). This estimate was used to calculate the expected number of collision related deaths annually, based on the length of transmission line (in kilometres) that will run through white-tailed ptarmigan habitat.

Residual Effect Analysis

In BC, white-tailed ptarmigan breed between the first week of May and the middle of September (Martell 2015). To avoid incidental mortality of adults, chicks, or eggs, vegetation clearing or ground disturbance will be avoided within ptarmigan nesting habitat during the breeding season. If clearing must occur during this sensitive period, then pre-clearing nest surveys will be conducted to minimize potential for incidental take of ptarmigan.

There are 2 km of Powerline planned within alpine habitat, which white-tailed ptarmigan could travel through year-round. Using a collision rate of 3.4 collisions/km/year (Bevanger 1995), it is estimated there could be seven mortalities of white-tailed ptarmigan associated with this section of Powerline per year. Over the life of the Project, this would result in total mortality estimate of 56 white-tailed ptarmigan resulting from the Powerline. The daily aggregate bag limit for ptarmigan is 10 and the aggregate possession limit is 30 within the Skeena hunting region (FLNRO 2016b); so expected annual Powerline mortality associated with the Project would be less than one additional hunter meeting the daily bag or aggregate possession limit. Mitigation measures to make transmission lines more visible to flying birds could further reduce mortality risk (Rioux et al. 2013).

Characterization of Residual Effect

The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The magnitude of effects on direct mortality was considered low because most potential sources of mortality could be effectively mitigated, and estimates of Powerline collisions were less than 10 mortalities per year. Residual effects of mortality are considered local because any mortality would occur within the Project boundaries and could influence population density within the LSA. The duration is long-term because mortalities could occur any time within the Construction, Operation, and Closure and Reclamation Phase. Effects of mortality were considered reversible at the population level, because high reproductive rates and immigration can compensate for mortalities (Martin et al. 2015). Frequency of mortality effects was rated as sporadic.

White-tailed ptarmigan are rated as having high context. This species has a high reproductive rate, with juveniles reaching reproductive maturity by 9 to 10 months generation times between 1.9 and 2.62 years (Martin et al. 2015). Ptarmigans can also recover from periods of low survival through immigration from nearby populations (Martin et al. 2015).

Likelihood

Moderate. While it is expected that the mitigation measures outlined in Section 16.6 will be effective in reducing direct mortality risk for non-migratory game birds, there is some probability that mortalities will still occur during the life of the Project.

Significance

Not significant. There are likely to be residual effects of direct mortality on white-tailed ptarmigan; however, these effects are assessed as not significant because they are low in magnitude, local in extent, reversible, and sooty grouse resiliency was rated as high.

Confidence and Risk

Moderate. There is specific information available on the mortality associated with collisions for white-tailed ptarmigan that supports the assessment and the cause-effect relationship between the Project and sooty grouse. The confidence is moderated as the effectiveness of mitigation measures for direct mortalities is moderate and the applicability of the supporting data is also moderate. The models used to estimate Powerline-related mortalities are based on a similar species in similar habitat, but this may not accurately reflect mortality risk for white-tailed ptarmigan in the LSA.

16.7.13 Potential Residual Effects Assessment — Amphibians

The assessment for amphibians focused on western toad, which is a species of Special Concern under the SARA. The Columbia spotted frog was also observed during baseline studies, and its habitat requirements are similar to western toad breeding habitat (Corkran and Thoms 2006). Coastal tailed frog, a SARA-listed species, is not expected to occur within the LSA or RSA based on extent of range and baselines studies and was dropped as a VC.

Western toads were assessed for potential Project related effects of habitat alteration, disruption to movement, direct and indirect mortality, chemical hazards, and attractants.

Attractants and indirect mortality associated with attraction to and entrapment within Project infrastructure (e.g., sumps, holding ponds) are noted as potential effects; however, the management of attractants and implementation of wildlife exclusion measures are expected to be effective mitigation actions. Similarly, potential effects associated with chemical hazards are expected to be effectively mitigated through appropriate storage, handling, and water quality testing, and thus are not anticipated as potential residual effects.

Effects assessment for amphibians was based on the Wildlife LSA. This was selected as the assessment boundary due to the smaller home range of this species compared to other Wildlife VC species. The LSA was considered the appropriate biological study area to assess amphibians.

Following further assessment of habitat alteration, disruption to movement (measured as habitat distribution), and mortality as potential residual effects for western toad, all three effects were predicted to have a negligible effect that will not result in residual effects of the Project. The rationale for this is provided below.

16.7.13.1 Habitat Availability

Habitat alteration was evaluated based on direct and indirect effects resulting from the Project footprint. Indirect effects could occur through changes in wetland function due to drainage pattern alteration or changes in water quality as a result of surface run off from developed areas, including the Access Road.

16.7.13.1.1 Residual Effect Analysis

The LSA contains 94 ha of high and moderate reproducing habitat for western toad. Herb-dominated wetlands and riparian areas are considered as high suitability breeding habitat, while shrub-dominated wetlands and riparian areas are considered as moderate to low suitability. This habitat occurs predominately in the valley bottom of the LSA and scattered within floodplain areas of Bitter Creek and low gradient tributaries. As identified in the Wildlife Baseline Report (Appendix 16-A), high quality breeding habitat was noted at Clements Lake and a small wetland near Highway 37, in the northwestern boundary of the LSA (Figure 16.7-31).

Potential alteration of effective western toad reproducing habitat is limited to moderate quality habitat. No high quality breeding habitat is located within the Project footprint. The Project footprint overlaps with less than 1 ha (or less than 1%) of effective reproducing habitat within the LSA (Table 16.7-21).

Habitat loss and alteration is not predicted to result in a residual effect on western toads within the LSA. Potential habitat loss or alteration will be limited to the pre-disturbed road corridor from Highway 37 to the Process Plant. Indirect effects are also not predicted to result in a residual effect. Overlap of habitat alteration to wetland ecosystems with western toad habitat modelling showed that these areas were low to nil breeding habitat suitability for western toad. In addition, potential effects to western toad habitat through changes in water quality and quantity as a result of road run-off and changes in drainage patterns will be avoided by adherence to BC Water Quality Guidelines and mitigated through use of erosion and sediment control. Several management plans provide these mitigation measures (Volume 5, Chapter 29).

Table 16.7-21: Summary of Change in Habitat Availability — Western Toad

Habitat Type	Area of Altered Habitat (ha)	Area of Sensory Disturbance (ha)	Total Habitat Change (ha)	LSA – Total Habitat (ha)	LSA – Habitat Change (%)
Breeding	<1	0	<1	94	<1

16.7.13.2 Habitat Distribution

Aggregation at commonly used breeding sites and long distance migrations of up to several kilometres make western toad populations vulnerable to habitat fragmentation or other barriers to movement. Adults migrate to breeding areas typically in the spring (May–June) and return to foraging and overwintering areas in summer. Toadlets emerge from ponds in late July or August and disperse *en masse* to foraging habitat within forest cover. Road networks can hamper these migrations, fragmenting terrestrial habitat from breeding areas. However, loss of vegetation does not appear to inhibit movements of adult western toads. Deguise and Richardson (2009) found adults were individuals were readily able to move through young (less than 5 years) clear-cuts and across forestry roads.

16.7.13.2.1 Residual Effect Analysis

Effects of habitat fragmentation are not predicted to result in a residual effect on western toads. The Project footprint overlaps a negligible amount of effective habitat within the LSA and does not include high quality breeding habitat. In addition, the proposed road and transmission line corridor is anticipated to use a predominantly pre-disturbed corridor.

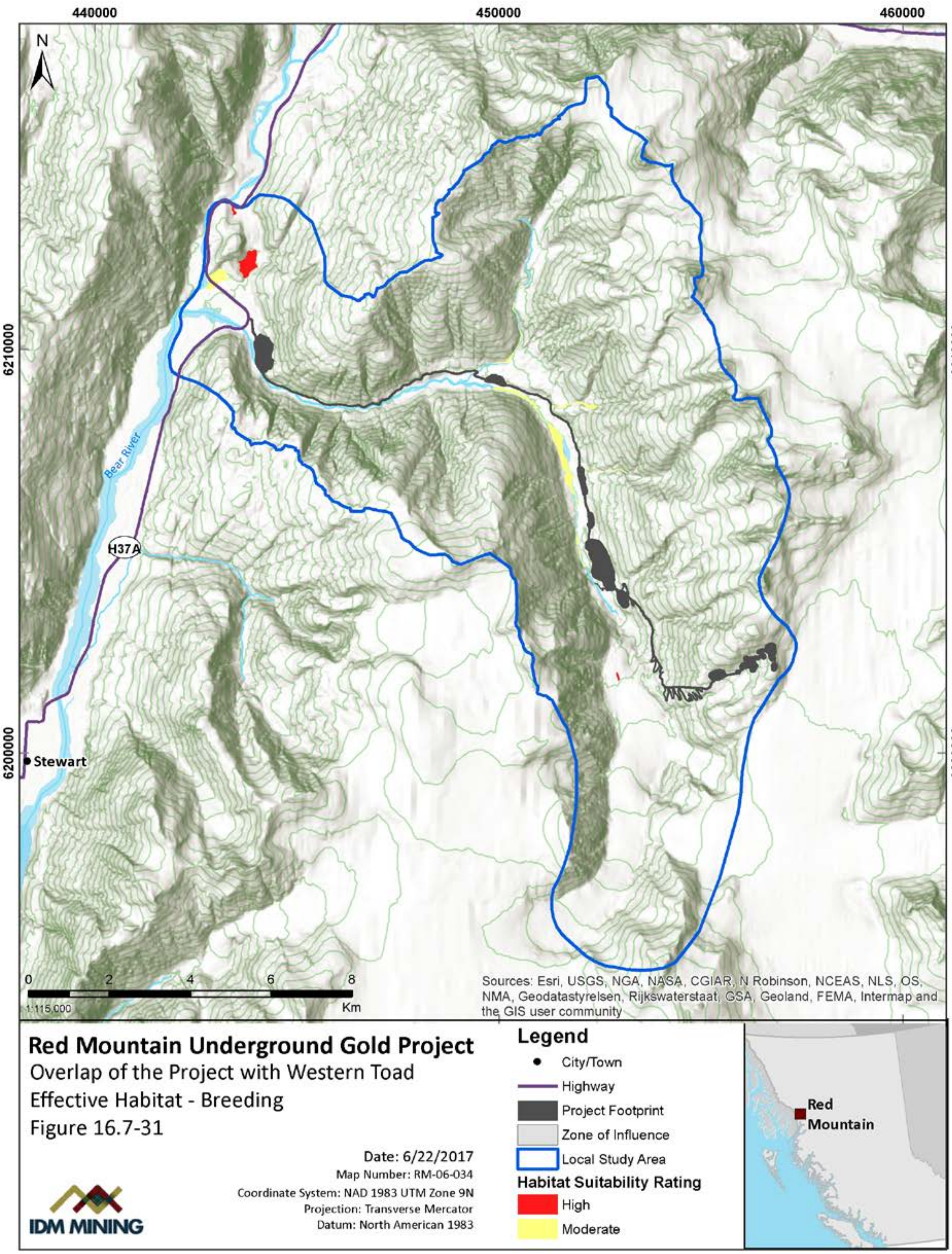
16.7.13.3 Mortality Risk

Potential sources of direct mortality on western toads are by majority vehicle collisions. These may occur by equipment during vegetation clearing and by vehicle collisions throughout the Project Construction, Operation, and Closure and Reclamation Phases. Simulation studies have demonstrated that high risk of adult mortality on roads (greater than 10%) could lead to reduced population size or local population extirpation in amphibian species with long generation times and slow movement rates (Gibbs and Shriver 2005). Adult toads are thought to make most dispersal movements at night while remaining stationary during the day (Bartelt et al. 2004).

16.7.13.3.1 Residual Effect Analysis

The effect of vegetation clearing is not predicted to result in a residual effect on western toad. The Project footprint overlaps a negligible amount of effective habitat within the LSA and does not include high quality breeding habitat. The effect of vehicle collisions is not predicted to result in a residual effect on western toads. Concentrations of adults and toadlets are not expected to occur along the proposed access corridor due to the negligible amount of effective habitat that overlaps the road. Vehicle traffic will be minimized through use of shuttles for crew changes and roads will be closed to public usage (Section 16.6.1.6). In the event large concentrations of western toads are observed, an adaptive management approach to wildlife protection protocols will be used and additional mitigation will be implemented as needed to minimize mortality.

Figure 16.7-31: Overlap of the Project with Western Toad Effective Habitat — Breeding



16.7.14 Summary of Residual Effects Assessment

These potential effects were identified as residual effects for certain VCs: habitat alteration, sensory disturbance, disruption to movement, and direct mortality. The results of significance characterizations are summarized in Table 16.7-22. All residual effects were identified as Not Significant. Overall, residual effects were predicted to be low to moderate in magnitude, and occurring at either a discrete or local extent. Residual effects were identified as being long-term in duration, occurring from Construction Phase through to Post-Closure Phase, and primarily as reversible or partially reversible.

Of the 11 Wildlife VCs and 19 individual species that were assessed, Project-related residual effects on habitat availability were predicted for all VCs except amphibians (western toad). Habitat availability is the measurement indicator that is the sum of habitat alteration and sensory disturbance (where applicable to the species). Residual effects on disruption to movement, which was measured as habitat distribution, were limited to mountain goat and marten. Residual effects on mortality risk as a result of the Project were identified for: mountain goat, grizzly bear, moose, marten, hoary marmot, common nighthawk, marbled murrelet, sooty grouse, and white-tailed ptarmigan.

Table 16.7-22: Summary of Residual Project Effects on Wildlife

Valued Component	Residual Effect	Project Phase(s)	Mitigation Measures	Summary of Residual Effects Characterization *(context, magnitude, geographic extent, duration, frequency, reversibility)*	Likelihood *(High, Moderate, Low)*	Significance *(Significant, Not Significant)*	Confidence *(High, Moderate, Low)*
Mountain Goat	Habitat Availability	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols	Context: Low to Neutral Magnitude: Low Extent: Local Duration: Long-term Frequency: Continous Reversibility: Reversible	High	Not Significant	Moderate
	Habitat Distribution	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols	Context: Low to Neutral Magnitude: Low Extent: Local Duration: Long-term Frequency: Continuous Reversibility: Reversible	High	Not Significant	Low
	Mortality	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Education Program, Wildlife Protection Protocols, Manage Vehicle Traffic	Context: Neutral Magnitude: Neglibigle to Low Extent: Local Duration: Long-term Frequency: Regular and Continuous Reversibility: Partially Reversible	Low	Not Significant	Moderate to High

Valued Component	Residual Effect	Project Phase(s)	Mitigation Measures	Summary of Residual Effects Characterization *(context, magnitude, geographic extent, duration, frequency, reversibility)*	Likelihood *(High, Moderate, Low)*	Significance *(Significant, Not Significant)*	Confidence *(High, Moderate, Low)*
Grizzly Bear	Habitat Availability	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols	Context: High Magnitude: Low Extent: Local Duration: Long-term Frequency: Continuous Reversibility: Reversible	High	Not Significant	Moderate
	Mortality	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Education Program, Wildlife Protection Protocols, Manage Vehicle Traffic	Context: Neutral Magnitude: Low Extent: Local Duration: Long-term Frequency: Sporadic Reversibility: Reversible	Low	Not Significant	High
Moose	Habitat Availability	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols	Context: High Magnitude: Low Extent: Local Duration: Long-term Frequency: Continuous Reversibility: Reversible	High	Not Significant	High
	Mortality	Construction Operation Closure and Reclamation	Wildlife Protection Protocol, Manage Attractants, Manage Vehicle Traffic	Context: Low Magnitude: Moderate Extent: Discrete Duration: Long-term Frequency: Sporadic Reversibility: Reversible	Low	Not Significant	Moderate

Valued Component	Residual Effect	Project Phase(s)	Mitigation Measures	Summary of Residual Effects Characterization *(context, magnitude, geographic extent, duration, frequency, reversibility)*	Likelihood *(High, Moderate, Low)*	Significance *(Significant, Not Significant)*	Confidence *(High, Moderate, Low)*
Marten	Habitat Availability	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols	Context: High Magnitude: Low Extent: Local Duration: Long-term Frequency: Continous Reversibility: Reversible	High	Not Significant	High
	Habitat Distribution	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols	Context: High Magnitude: Low Extent: Local Duration: Long-term Frequency: Continous Reversibility: Reversible	Low	Not Significant	High
	Mortality	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Education Program, Wildlife Protection Protocols, Manage Vehicle Traffic	Context: Neutral Magnitude: Low Extent: Discrete Duration: Long-term Frequency: Sporadic Reversibility: Reversible	Low	Not Significant	High
Wolverine	Habitat Availability	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols	Context: High Magnitude: Low Extent: Local Duration: Long-term Frequency: Continuous Reversibility: Reversible	Moderate	Not Significant	Moderate

Valued Component	Residual Effect	Project Phase(s)	Mitigation Measures	Summary of Residual Effects Characterization *(context, magnitude, geographic extent, duration, frequency, reversibility)*	Likelihood *(High, Moderate, Low)*	Significance *(Significant, Not Significant)*	Confidence *(High, Moderate, Low)*
Hoary Marmot	Habitat Availability	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols	Context: Neutral Magnitude: Low Extent: Discrete Duration: Long-term Frequency: Continuous Reversibility: Reversible	High	Not Significant	Moderate
	Mortality	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Education Program, Wildlife Protection Protocols, Manage Vehicle Traffic	Context: Neutral Magnitude: Moderate Extent: Discrete Duration: Long-term Frequency: Sporadic Reversibility: Reversible	Moderate	Not Significant	Moderate
Bats	Habitat Availability	Construction Operation Reclamation and Closure	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols	Context: Hight Magnitude: Moderate Extent: Discrete Duration: Long-term Frequency: Continuous Reversibility: Reversible	Moderate	Not Significant	Moderate
Habitat Guilds	Habitat Availability	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols	Context: High Magnitude: Low Extent: Local Duration: Long-term Frequency: Continuous Reversibility: Reversible	High	Not Significant	Moderate

Valued Component	Residual Effect	Project Phase(s)	Mitigation Measures	Summary of Residual Effects Characterization *(context, magnitude, geographic extent, duration, frequency, reversibility)*	Likelihood *(High, Moderate, Low)*	Significance *(Significant, Not Significant)*	Confidence *(High, Moderate, Low)*
Black Swift	Habitat Availability	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols	Context: Low Magnitude: Low Extent: Local Duration: Long-term Frequency: Continuous Reversibility: Reversible	Moderate	Not Significant	Moderate
Common Nighthawk	Habitat Availability	Construction Operation Closure and Reclamation	Project Design, Wildlife Education Program, Wildlife Protection Protocols, Minimize Habitat Disturbance	Context: Low Magnitude: Low Extent: Local Duration: Long-term Frequency: Continuous Reversibility: Reversible	Moderate	Not Significant	Moderate
	Mortality	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols, Manage Vehicle Traffic	Context: Low Magnitude: Low Extent: Discrete Duration: Long-term Frequency: Sporadic Reversibility: Reversible	Low	Not Significant	High
MacGillivray's Warbler	Habitat Availability	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols	Context: High Magnitude: Low Extent: Local Duration: Long-term Frequency: Continuous Reversibility: Reversible	High	Not Significant	High

Valued Component	Residual Effect	Project Phase(s)	Mitigation Measures	Summary of Residual Effects Characterization *(context, magnitude, geographic extent, duration, frequency, reversibility)*	Likelihood *(High, Moderate, Low)*	Significance *(Significant, Not Significant)*	Confidence *(High, Moderate, Low)*
Marbled Murrelet	Habitat Availability	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols	Context: Neutral Magnitude: Low Extent: Local Duration: Long-term Frequency: Continuous Reversibility: Reversible	Moderate	Not Significant	Moderate
	Mortality	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols	Context: Neutral Magnitude: Low Extent: Local Duration: Long-term Frequency: Sporadic Reversibility: Reversible	Moderate	Not Significant	Moderate
Olive-sided Flycatcher	Habitat Availability	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols	Context: Low Magnitude: Low Extent: Local Duration: Long-term Frequency: Continuous Reversibility: Reversible	High	Not Significant	Moderate
Northern Goshawk	Habitat Availability	Construction Operation Closure and Reclamation	Project Design, Wildlife Education Program, Wildlife Protection Protocols, Minimize Habitat Disturbance	Context: Low Magnitude: Moderate Extent: Local Duration: Long-term Frequency: Continuous Reversibility: Reversible	High	Not Significant	Moderate

Valued Component	Residual Effect	Project Phase(s)	Mitigation Measures	Summary of Residual Effects Characterization *(context, magnitude, geographic extent, duration, frequency, reversibility)*	Likelihood *(High, Moderate, Low)*	Significance *(Significant, Not Significant)*	Confidence *(High, Moderate, Low)*
Western Screech-owl	Habitat Availability	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols	Context: Low Magnitude: Low Extent: Local Duration: Long-term Frequency: Continuous Reversibility: Reversible	High	Not Significant	Moderate
Sooty Grouse	Habitat Availability	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols	Context: High Magnitude: Low Extent: Local Duration: Long-term Frequency: Continuous Reversibility: Reversible	High	Not Significant	High
	Mortality	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols, Manage Attractants	Context: High Magnitude: Low Extent: Local Duration: Long-term Frequency: Sporadic Reversibility: Reversible	Moderate	Not Significant	Moderate
White-tailed Ptarmigan	Habitat Availability	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols	Context: High Magnitude: Low Extent: Local Duration: Long-term Frequency: Continuous Reversibility: Reversible	High	Not Significant	High

Valued Component	Residual Effect	Project Phase(s)	Mitigation Measures	Summary of Residual Effects Characterization *(context, magnitude, geographic extent, duration, frequency, reversibility)*	Likelihood *(High, Moderate, Low)*	Significance *(Significant, Not Significant)*	Confidence *(High, Moderate, Low)*
	Mortality	Construction Operation Closure and Reclamation	Project Design, Minimize Habitat Disturbance, Wildlife Protection Protocols, Manage Attractants	Context: High Magnitude: Low Extent: Local Duration: Long-Term Frequency: Sporadic Reversibility: Reversible	Moderate	Not Significant	Moderate

Context: N-negligible; L-low; Moderate-moderate; H-high
Magnitude: N-negligible; L-low; Moderate-moderate; H-high
Extent: D-discrete; L-local; R-regional; BR-beyond regional
Duration: ST-short-term; LT-long-term; P-permanent
Frequency (of occurrence): O-one time; S-sporadic; R-regular; C-continuous
Reversibility: I-irreversible; PR-partially reversible; R-reversible

16.8 Cumulative Effects Assessment

Cumulative effects are the result of Project residual effects interacting with residual effects of other physical activities (i.e., anthropogenic developments, projects, or activities) that have been or will be carried out (CEAA 2014).

Guidance documents specific to the cumulative effects methodology are identified below:

- A Reference Guide for the Canadian Environmental Assessment Act: Addressing Cumulative Environmental Effects (CEAA 1994);
- Practitioners Glossary for the Environmental Assessment of Designated Projects under the *Canadian Environmental Assessment Act, 2012* (CEAA 2015b);
- Guideline for the Selection of Valued Components and Assessment of Potential Effects. British Columbia Environmental Assessment Office (EAO 2013);
- Assessing Cumulative Environmental Effects under the *Canadian Environmental Assessment Act, 2012*, Operational Policy Statement (CEAA 2015a); and
- Draft Technical Guidance for Assessing Cumulative Environmental Effects under the *Canadian Environmental Assessment Act, 2012* (CEAA 2014).

16.8.1 Cumulative Effects Assessment Boundaries

Cumulative Effects Assessment (CEA) boundaries are consistent with those used in the Residual Effects Assessment (Section 16.3.4).

16.8.1.1 Spatial Boundaries

The extent of the spatial boundary used in the CEA is the RSA for all Wildlife VCs except for hoary marmot and bats that are assessed in the LSA. These boundaries are defined in Section 16.3.4.

16.8.1.2 Temporal Boundaries

The temporal boundaries for the assessment of cumulative effects on wildlife encompass the periods during which the proposed Project-related residual effects are expected to interact with residual effects of other past, present, or reasonably foreseeable future projects and activities. The following temporal boundaries are evaluated as part of each CEA:

1. Past: 1988 to 2014 (includes projects that are active and ones that are inactive);
2. Present: 2014 to 2017, from the start of the Project’s detailed baseline studies to the completion of the effects assessment; and

3. Foreseeable Future: The cut-off date for incorporating any new future developments in the CEA is 2029. This represents the final anticipated year of the mine life after the Post-Closure Phase is complete.

16.8.2 Identifying Past, Present, and Reasonably Foreseeable Projects and/or Activities

Within the RSA, there are a number of human activities as well as current infrastructure and reasonably foreseeable projects that may spatially or temporally overlap with residual effects of the Project (Table 16.8-1;Figure 16.8-1). Historically, logging and mining activities have occurred in the RSA and these activities are likely to continue into the future. Public recreation and hunting, trapping, and fishing activities also occur and will continue to occur into the future.

The list of past, present, and reasonably foreseeable projects and/or activities for consideration in the CEA was compiled from a variety of information sources, including municipal, regional, provincial, and federal government agencies and company websites.

For identified cumulative effects, the following development categories will be considered in the Application/EIS:

1. Certain (past and present): Projects or activities that have already been built or conducted for which the environmental effects overlap with those of the proposed Project; and

2. Reasonably foreseeable: Projects that are either proposed (public disclosure) or have been approved to be built but are not yet built, for which the environmental effects overlap the proposed Project.

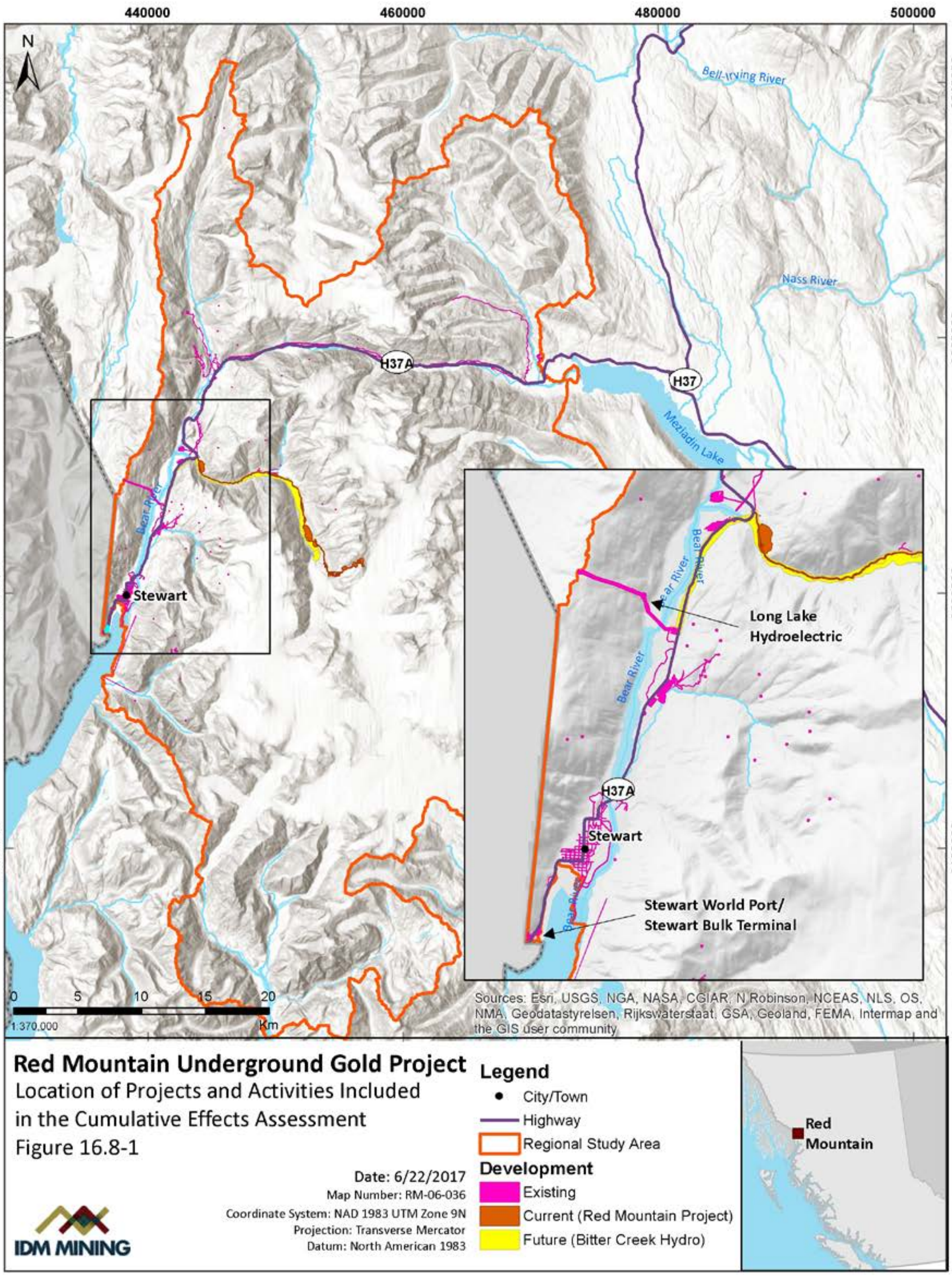
A list of past, present, and reasonably foreseeable projects and activities that occur with the Wildlife RSA is provided below in Table 16.8-1. A description of each project considered for the CEA is provided immediately following Table 16.8-1.

Table 16.8-1: List of Projects and Activities Included in the Cumulative Effects Assessment

Project/Activity	Project Life	Location	Proponent
Stewart Bulk Terminals	Currently Operating	Stewart	Stewart Bulk Terminals Ltd.
Stewart World Port	Currently Operating	Stewart	Stewart World Port
Highway 37A	Currently Operating	Stewart	MOTI
Long Lake Hydroelectric Project	Currently Operating	25km east of Stewart	Long Lake Hydro Inc.
Bitter Creek Hydro Project	Proposed	Bitter Creek valley, 15 km northeast of Stewart	Bridge Power

Project/Activity	Project Life	Location	Proponent
Commercial Recreation	Ongoing	Regional	Various
Forestry	Ongoing	Regional	Various
Guide Outfitting	Ongoing	Regional	Various
Hunting	Ongoing	Regional	Various
Mineral Exploration	Ongoing	Regional	Various
Parks and Protected Areas	Ongoing	Regional	Various
Transportation	Ongoing	Regional	Various
Trapping	Ongoing	Regional	Various

Figure 16.8-1: Location of Projects and Activities Included in the Cumulative Effects Assessment



16.8.2.1 Past and Present Projects

16.8.2.1.1 Stewart Bulk Terminals

Stewart Bulk Terminals is an expansion project of an operating bulk storage and loading marine terminal located near the Salmon River delta in Stewart to provide the ability to load/unload containers and bulk cargo. It is owned by Stewart Bulk Terminals Ltd. The new wharf and a structure provide servicing for barges at all stages of the tide. The project includes a sheet pile, fill wharf and rip-rap slope construction, dredging activities, modifications to the Stewart-Hyder road, traffic management on the Stewart-Hyder road, vessel management, and associated gravel extraction and rock quarrying activities (EAO 2002).

16.8.2.1.2 Stewart World Port

The Stewart World Port is an upgrade project of dock lands and a bulk export log handling facility at the Port of Stewart owned by Stewart World Port. The multipurpose port facility is located at the end of the Portland Canal, 2 km south of Stewart (District of Stewart 2017). It is complete and became operational in 2015. It included a refurbishment of the existing dock, recreational boat launch, addition of a barge ramp, construction of a two boat-loading docks, and port handling facilities, including concentrate sheds, conveying systems, and ship loader for outbound bulk cargo.

16.8.2.1.3 Long Lake Hydroelectric Project

The Long Lake Hydroelectric Project is a run-of-river hydroelectric power facility located approximately 17 km north of Stewart on Cascade Creek. It is owned and operated by Long Lake Joint Venture. Construction began July 2010, operations commenced in December 2013, and the anticipated project life is 80 years. The generation site includes a 20 m high rockfill dam, 7.2 km long penstock, powerhouse, tailrace, and a 10-km 138-kV transmission line that connects to BC Hydro's 138-kV line and runs into Stewart. Production capacity of the hydroelectric project is 31 MW (CEA Agency 2012). The project employed up to 160 people during construction (NDIT 2012 in Rescan 2014). The project was predicted to create one or two full-time jobs during operation.

16.8.2.2 Reasonably Foreseeable Future Projects

16.8.2.2.1 Bitter Creek Hydro Project

The Bridge Power Hydro Developments Ltd. (Bridge Power) is seeking to obtain a long-term lease over the area which is currently identified under Investigative License (Bridge Power 2016). The project is located 15 km northeast of Stewart, in the Bitter Creek valley, and was originally perceived as a 30 MW project, designed for an open bidding process with BC Hydro. In 2015, it was decided to progress the project on a reduced scale as a 15-MW project as part of the BC Hydro Standing Offer Program. Since making this decision, Bridge Power has been made aware of the Project, which is located in the same vicinity. As of the date of this report, the Bitter Creek Hydro Project remains only in a concept and planning phase and the likelihood of it proceeding is uncertain.

16.8.2.3 Other Activities with Potential to Interact with the Project Effects

Land use activities that may interact cumulatively with the proposed Project components and activities directly or indirectly that are not identified as projects in Sections 16.8.2.1 and 16.8.2.2 are identified in Table 16.8-2 for activities that overlap with the RSA. Table 16.8-2 summarizes each of the activities that have occurred in the past, is presently occurring, and/or is anticipated to occur in the future. Where spatial data exists of where past projects occurred (e.g., mineral exploration), the data was incorporated into habitat availability assessments. Sensory disturbance was not a factor in the assessment of the activities listed below because past activities no longer have activity, the spatial location of future activities is uncertain, and other activities are impractical to spatially identify (i.e., hunting).

Table 16.8-2: Summary of Past, Present, and Reasonably Foreseeable Future Land Based Activities with Potential to Interact with the Project Effects

Activity	Description
Commercial Recreation	Commercial recreation, activities including heli-skiing, river rafting, fishing, lodging, guided mountaineering, guided freshwater recreation, and backcountry expeditions, have the potential to occur within the RSA (Rescan 2014). There is an interaction related to habitat alteration and sensory disturbance (habitat availability).
Forestry	The RSA falls within the Nass and North Coast Timber Supply Areas (TSAs). There is interaction related to habitat alteration and sensory disturbance (habitat availability).
Guide Outfitting	Targeted species include bear (black and grizzly), deer, moose, mountain goat, and wolf (Rescan 2014). There is one guide outfitting licence in the RSA. Hunting guide tenures are accessed by truck, plane, foot, or ATV. There is an interaction related to mortality risk.
Hunting	Hunting is an important activity for sustenance, recreation, and the economy. There are two MUs that overlap the RSA: MU 6-14 and MU 6-16. The key species hunted include deer, moose, mountain goat, bear (black and grizzly), and wolf. There is an interaction related to mortality risk.
Mineral Exploration	There are 44 individuals or companies holding mineral claims in the RSA. There is an interaction related to habitat alteration and sensory disturbance (habitat availability).
Parks and Protected Areas	Two provincial parks fall within the RSA: Bear Glacier Provincial Park is approximately 15 km and the Meziadin Provincial Park is approximately 18 km from the Project, respectively. There is no interaction with the Project.
Trapping	Trapping is an important activity for sustenance, recreation, and the economy in the region. There are 12 trapping licenses that intersect the RSA. There is an interaction related to mortality risk.
Transportation	Highway 37A is located east of the proposed Project and is the primary road that crosses the RSA. The closest airstrip to the Project is at Stewart. There is an interaction related to habitat alteration and sensory disturbance (habitat availability).

Traditional and cultural activities occur in the region, including hunting, fishing, trapping, and gathering. It is IDM's understanding that Aboriginal Groups manage the potential effects of these activities on wildlife through traditional or cultural land and resource management structures. It is also IDM's understanding that traditional and cultural use of the Bitter Creek valley is low based on lack of access and distance from the Nass Valley.

16.8.3 Potential Cumulative Effects

When a Project-related residual effect interacts with the effects of other projects or activities to produce a combined effect it is considered a cumulative effect. The method for assessing potential cumulative effects will generally follow the same steps as the Project-specific effects assessment. Federal guidance states that a CEA should be carried out on VCs for which residual effects have been predicted after consideration of mitigation measures, regardless of their significance (CEAA 2014).

Each of the Wildlife VCs had residual effects with the exception of amphibians. The following residual effects were carried forward as potential cumulative effects for each VC. The potential cumulative effects are assessed using their associated measurement indicators as defined in Section 16.7.1: habitat availability, habitat distribution and mortality risk.

- Mountain goat: habitat availability, habitat distribution, mortality risk
- Grizzly bear: habitat availability, mortality risk
- Moose: habitat availability, mortality risk
- Furbearers: habitat availability, habitat distribution (marten), mortality risk (marten)
- Hoary marmot: habitat availability, mortality risk (species assessed at LSA level)
- Bats: habitat availability, mortality risk (species assessed at LSA level)
- Migratory breeding birds: habitat availability
- Migratory bird species at risk: habitat availability, mortality risk (common nighthawk, marbled murrelet)
- Raptors: habitat availability
- Non-migratory game birds: habitat availability, mortality risk

16.8.3.1 Potential for Cumulative Effects – Mountain Goat

Three residual effects (habitat availability, habitat distribution, and mortality risk) could potentially have a cumulative effect on mountain goat. The Project residual effect of habitat availability will not interact with habitat availability caused by habitat alteration from past projects since none have occurred within effective mountain goat habitat. Habitat alteration and sensory disturbance from present and future projects that could result in a minor loss of habitat has a very low possibility since the proposed Bitter Creek Hydro project footprint does not occur within effective summer or winter mountain goat habitat. Sensory disturbance from the proposed Bitter Creek Hydro project could possibly affect mountain goat habitat availability.

Based on current information, none of the past, present, or future projects would cause a disruption of movement measured as an effect on habitat distribution for mountain goats because they are not located in suitable goat habitat. Only the Project has the potential to affect mountain goat habitat distribution. No cumulative effect is associated with Project's habitat distribution residual effect.

Two potential sources of mortality risk for mountain goats are associated with the Project: new road access in the Bitter Creek valley, which could facilitate better access into the area for licensed and unlicensed hunters, and vehicle collision risk. Specific mitigation measures to minimize mortality from these sources are expected to be effective to limit potential mortality risk to mountain goats and the magnitude is predicted to be very low. Mortality risk caused by vehicle collision and hunting from past, present, and future projects and activities are not expected to result in an additive cumulative effect. The majority of roadways and traffic occurs at lower elevations within the Bear River valley and outside of effective mountain goat habitat. This also limits hunter access to higher elevation mountain goat habitat.

16.8.3.2 Potential for Cumulative Effects – Grizzly Bear

Two residual effects (habitat availability and mortality risk) are predicted to have a potential cumulative effect on grizzly bear. This residual effect has the potential to interact with habitat availability caused by habitat alteration from past, present, and future projects and activities, and caused by sensory disturbances from present and future activities. This interaction could result in a nibbling loss of habitat. The total past, present, and proposed disturbance footprint represents 0.7% of the RSA. Of this, many of the disturbances, such as older cut blocks and transmission lines, currently provide shrub and early seral forest conditions, including berry-producing habitats that are commonly used by grizzly bear for foraging.

The residual Project-related effect of mortality risk could interact with mortality risk caused by human conflicts, vehicle collision, and hunting from past, present, and future projects and activities which could result in an additive cumulative effect. Roads are considered of particular concern to grizzly bears primarily due to increase human access, which can result in increased mortality due to conflict, hunting pressure, and vehicle collision, in addition to habitat-related effects.

16.8.3.3 Potential for Cumulative Effects – Moose

Two residual effects (habitat availability and mortality risk) are predicted to have a potential cumulative effect on moose. This residual effect has the potential to interact with habitat availability caused by habitat alteration from past, present, and future projects and activities and caused by sensory disturbances from present and future activities. This interaction could result in a nibbling loss of habitat. The total past, present, and proposed disturbance footprint represents 0.7% of the RSA. Of this, many of the disturbances, such as older cut blocks and transmission lines, currently provide shrub and early seral forest conditions commonly used by moose.

The residual effect of mortality risk could interact with mortality risk caused by vehicle collision and access into hunting areas from past, present, and future projects and activities, which could result in an additive cumulative effect. Moose harvest data indicates that no moose were harvested in MU 6-14 since 2011. Moose direct mortality due to vehicle collision in the RSA is most likely to occur along Highway 37A.

16.8.3.4 Potential for Cumulative Effects – Furbearers

Three residual effects (habitat availability, habitat distribution, and mortality risk) are predicted to have a potential cumulative effect on marten. The Project-related residual effect of habitat availability could interact with habitat availability caused by habitat alteration from past projects and activities, as well as due to habitat alteration and sensory disturbance from present and future activities, which could result in a nibbling loss of habitat.

The residual effect of habitat distribution could interact with habitat distribution caused by disruption to movement from past, present, and future projects and activities and result in an additive cumulative effect.

The residual effect of mortality risk could interact with mortality risk caused by vehicle collision and incidental take during vegetation clearing from past, present, and future projects and activities, which could result in an additive cumulative effect for marten.

One residual effect (habitat availability) is a potential cumulative effect on wolverine. This residual effect has the potential to interact with habitat availability caused by habitat alteration from past, present, and future projects and activities and caused by sensory disturbances from present and future activities. This interaction could result in a minor loss of habitat.

16.8.3.5 Potential for Cumulative Effects – Hoary Marmot

The Project-related residual effect of habitat availability does not interact with habitat availability caused by habitat alteration from past or future projects within the RSA. None of the known past projects, with exception of a very small area of mineral exploration, occur in the alpine or parkland areas of the RSA, and the proposed Bitter Creek Hydro Project footprint does not overlap with any effective hoary marmot habitat. No cumulative habitat availability residual effect is predicted for hoary marmot.

The residual effect of mortality risk will not interact with mortality risk caused by vehicle collision or incidental take where dens could be destroyed due to ground disturbances from past or future projects. The residual effect of mortality risk is not considered an effect that will have a cumulative residual effect in the RSA since no other project is associated with effective hoary marmot habitat.

16.8.3.6 Potential for Cumulative Effects – Bats

One residual effect (habitat availability) is predicted to have a potential cumulative effect on bats. This Project-related residual effect has the potential to interact with habitat availability caused by habitat alteration from past projects and activities, as well as due to habitat alteration from present and future activities to result in a minor loss of habitat.

16.8.3.7 Potential for Cumulative Effects – Migratory Breeding Birds

One residual effect (habitat availability) is predicted to have a potential cumulative effect on migratory breeding birds. This residual effect has the potential to interact with habitat availability caused by habitat alteration from past, present, and future projects and activities and caused by sensory disturbances from present and future activities. This interaction could result in a minor loss of habitat.

16.8.3.8 Potential for Cumulative Effects – Migratory Birds Species at Risk

The residual effect habitat availability is predicted to have a potential cumulative effect on migratory bird species at risk. This residual effect has the potential to interact with habitat availability caused by habitat alteration from past, present, and future projects and activities and caused by sensory disturbances from present and future activities. This interaction could result in a minor loss of habitat.

The residual effect mortality risk is predicted to have a potential cumulative effect on common nighthawk and marbled murrelet. The residual effect of mortality risk could interact with mortality risk caused by vehicle collision, incidental take during vegetation clearing and ground disturbances, and collision and electrocution from powerlines related to past, present, and future projects and activities, which could result in an additive cumulative effect.

16.8.3.9 Potential for Cumulative Effects – Raptors

One residual effect (habitat availability) is predicted to have a potential cumulative effect on raptors. This residual effect has the potential to interact with habitat availability caused by habitat alteration from past, present, and future projects and activities and caused by sensory disturbances from present and future activities. This interaction could result in a minor loss of habitat.

16.8.3.10 Potential for Cumulative Effects – Non-migratory Game Birds

Two residual effects (habitat availability and mortality risk) are predicted to have a potential cumulative effect on non-migratory game birds. The residual effect of habitat availability could interact with habitat availability caused by habitat alteration from past, present, and future project and activities and caused by sensory disturbances related to present and future project and activities. This interaction could result in a minor loss of habitat.

The residual effect of mortality risk could interact with mortality risk caused by vehicle collision, incidental take during vegetation clearing and ground disturbances, and collision and electrocution from powerlines from past, present, and future projects and activities, which could result in an additive cumulative effect.

16.8.3.11 Mitigation Measures

Mitigation measures to minimize cumulative effects are often not the same as those implemented to reduce Project effects (Hegmann et al. 1999). Addressing cumulative effects often requires regional stakeholder involvement and government-led initiatives to implement effective management plans and monitoring programs. These types of mitigation measures are beyond the scope of this CEA. However, where possible, BMPs will be adopted and implemented to meet wildlife objectives described in the NSSRMP and North Coast LRMP (see Table 16.2-4). In addition, cumulative effects can be reduced through minimizing local Project-related effects by means of the mitigation measures described for the Project (refer to Section 16.6).

16.8.3.12 Cumulative Effects Interaction Matrix

To determine which potential cumulative effects listed above would be assessed in the residual cumulative effects assessment, the interactions among projects or activities were assessed. The potential cumulative effects interaction matrix presented in Table 16.8-3 was developed by considering the following questions or criteria:

1. A project/activity is within the RSA of a Wildlife VC with residual effects;

2. Residual effects of other projects and activities have affected the Wildlife VC that may also be affected by the Project; and/or

3. A high degree of confidence exists that the other project or activity would not interact with the residual effects of the Project.

Table 16.8-3: Past, Present, and Foreseeable Future Projects or Activities Interaction Matrix

Residual Project Effect	Past and Present Projects				Past, Present, Future Activities				Future Project	Project	Potential Cumulative Effect (Y/N)
	Highway 37A	Stewart Bulk Terminals	Stewart World Port	Long Lake Hydroelectric Project	Forestry	Mineral Exploration	Parks and Protected Areas	Commercial Recreation, Hunting, Trapping, Guide Outfitting	Bitter Creek Hydro Project	Red Mountain	
Mountain goat											
Habitat availability	N	N	N	Y	N	Y	N	N	Y	Y	Y
Habitat distribution	N	N	N	N	N	N	N	N	N	Y	N
Mortality risk	N	N	N	Y	Y	Y	N	Y	Y	Y	Y
Grizzly bear											
Habitat availability	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y
Mortality risk	Y	N	N	Y	Y	Y	N	Y	Y	Y	Y
Moose											
Habitat availability	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y
Mortality risk	Y	N	N	Y	Y	Y	N	Y	Y	Y	Y
Furbearers											
Habitat availability	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y
Habitat distribution (marten)	Y	N	N	Y	Y	Y	N	N	Y	Y	Y
Mortality risk (marten)	Y	N	N	Y	Y	Y	N	Y	Y	Y	Y
Hoary marmot											
Habitat availability	N	N	N	N	N	Y	N	N	N	Y	N
Mortality risk	N	N	N	N	N	Y	N	N	N	Y	N
Bats											
Habitat availability	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y

Residual Project Effect	Past and Present Projects				Past, Present, Future Activities				Future Project	Project	Potential Cumulative Effect (Y/N)
	Highway 37A	Stewart Bulk Terminals	Stewart World Port	Long Lake Hydroelectric Project	Forestry	Mineral Exploration	Parks and Protected Areas	Commercial Recreation, Hunting, Trapping, Guide Outfitting	Bitter Creek Hydro Project	Red Mountain	
Migratory breeding birds											
Habitat availability	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y
Migratory birds species at risk											
Habitat availability	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y
Mortality risk (common nighthawk, marbled murrelet)	Y	N	N	Y	Y	Y	N	N	Y	Y	Y
Raptors											
Habitat availability	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y
Non-migratory game birds											
Habitat availability	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y
Mortality risk	N	N	N	Y	Y	Y	N	N	Y	Y	Y

Y = Yes, interaction exists between the residual effect of the Project and the other past, current, or future project/activity

N = No, interaction does not exist between the residual effect of the Project and the other past, current, or future project/activity

16.8.4 Residual Cumulative Effects Assessment

Residual cumulative effects are those effects remaining after the implementation of all mitigation measures. The residual cumulative effects for each VC were characterized by considering all residual effects from past, present, and reasonably foreseeable projects and/or activities within the RSA, including the proposed Project. To create a non-overlapping spatial layer of all past, present, and reasonably foreseeable projects and/or activities within the RSA, the oldest projects and/or activities were incorporated first and then more recent projects and/or activities were added sequentially. When more recent projects and/or activities overlapped spatially with older projects and/or activities, the overlapping areas of the more recent projects and/or activities were not incorporated into the spatial layer because these areas were already captured in the CEA disturbance layer by the older project and/or activities. Mitigation measures summarized in Section 16.6and described in the WMP (Volume 5, Chapter 29) will be applied to address potential cumulative effects. No additional mitigation is proposed for potential cumulative effects.

16.8.4.1 Residual Cumulative Effects Assessment — Mountain Goat

Mountain goats were assessed for potential cumulative effects on habitat availability (habitat alteration and sensory disturbance) and mortality risk. The residual effect of habitat distribution is not considered an effect that would have a cumulative effect in the RSA since no other project is associated with alpine and parkland areas within the RSA. The Red Mountain Project is the only currently known project to cause a potential habitat distribution residual effect. Due to the potential for cumulative effects from past, present, and foreseeable future projects and activities on habitat availability and mortality risk, assessments of significance of those effects are presented below.

16.8.4.1.1 Habitat Availability

Habitat availability for mountain goats was assessed for the life requisite of general living during summer (May-October) and winter (November-April) seasons. The habitat models developed and used in the assessment followed the same methods as described in the residual effects assessment (Section 16.7.3.1).

Residual Cumulative Effects Analysis

The potential cumulative effects on habitat availability for mountain goats are summarized in Table 16.8-4. The extent of altered habitat for both summer and winter habitat is very small. The area affected by sensory disturbance is much larger, especially in summer. The distances used for the assessment of potential sensory disturbance was the same as for the residual effect assessment and is considered a precautionary approach for several reasons. The distances correspond to recommended buffer distances for helicopters and ground-based industrial activities to avoid their effects on mountain goats (MGMT 2010). As in the residual effects assessment, the effects of the disturbances were assumed to result in the complete loss of habitat within the zones of influence (area of sensory disturbance). This is likely an overestimate of the magnitude of the effect, since some studies have observed continued use of areas by mountain goat within these areas of sensory disturbances. It has been observed that within the Project LSA (Bitter Creek valley), mountain goats have continued to occupy the area and demonstrate widespread distribution within the valley during and after helicopter-accessed mineral exploration activities over the past years (Appendix 16-A).

Table 16.8-4: Summary of Change in Habitat Availability — Mountain Goat

Habitat Type	Past, Present, Future (ha)				Project (ha)		Future (ha)		Total Habitat Change (ha)	RSA – Total Habitat (ha)	Cumulative RSA Habitat Change (%)
	Highway 37A	Past and Present Projects[1]	Past, Present, Future Activities	Area of Sensory Disturbance[2]	Red Mountain	Area of Sensory Disturbance	Bitter Creek Hydro Project	Area of Sensory Disturbance			
Summer Living	0	11	8	87	<1	289	0	14	409	38,961	1
Winter Living	<1	0	19	0	0	0	3	0	24	10,390	<1

[1] Long Lake Hydroelectric Project, Stewart Bulk Terminals, Stewart World Port
[2] Area of sensory disturbance includes Hwy 37A and past/present projects

Characterization of Residual Cumulative Effect

Potential cumulative effects on habitat availability for mountain goats are adverse, primarily due by the reduction of habitat effectiveness via sensory disturbance. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The magnitude of the effect is low since the values for both summer (1%) and winter (less than 1%) living are within the level set as low magnitude. The geographic extent of the effect is predicted to be regional. The duration of the cumulative effects will be long-term. The frequency of the effects will primarily be continuous, corresponding to the estimated continuous operation of mechanized equipment by various projects, but some types of disturbances should be considered sporadic or regular. Project effects are anticipated to be reversible since the effects are largely driven by sensory disturbance associated with Project activities. Once Project activities cease, adverse effects on habitat availability will be removed. Mountain goats have a low to neutral context in terms of sensitivity or resiliency to Project effects. Although there are some cases where mountain goats have exhibited tolerance or habituation to industrial disturbances, the more consistent pattern among studies is that mountain goats avoid industrial disturbances, resulting in reduced habitat availability within the zone of sensory disturbance.

Likelihood

High. Adverse effects of helicopter operations and ground-based industrial activities on habitat availability of mountain goats (via reduced habitat use in response to sensory disturbance) are well documented in the literature (Foster and Rahs 1983; Côté 1996; Gordon and Wilson 2004; Goldstein et al. 2005).

Significance

Not significant. Residual effects on habitat availability for mountain goats were determined to be not significant due to the magnitude of moderate at the regional extent combined with the effects being reversible once mechanized activity associated with the Project ceases. The effects of the Red Mountain Project have a low magnitude at the regional extent.

Confidence and Risk

Moderate. The primary uncertainty associated with the prediction is the degree to which mountain goats are actually displaced by Project activities within the sensory disturbance zones, resulting in reduced habitat availability. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. The assumptions used in this assessment are precautionary, both in terms of the sizes of the disturbance ZOIs and magnitude of effect (i.e., complete loss of habitat), and likely overestimate potential Project effects on habitat availability. There is very low risk that the Project effects could exceed those used in this assessment. It is likely that mountain goats will continue to some use portions of the sensory disturbance ZOIs and the effects will be less than those used in this assessment. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.1.2 Mortality Risk

Two potential sources of mortality risk for mountain goats are associated with the new road access in the Bitter Creek valley, which could facilitate better access into the area for licensed and unlicensed hunters and vehicle collision risk associated with the Red Mountain Project combined with other projects and activities included in the cumulative effects assessment.

Residual Cumulative Effects Analysis

Potential mortality risk to mountain goats associated with the past, present, and one future project was assessed qualitatively because data to support a quantitative assessment were not available. Potential mortality risk associated with vehicle collision risk was predicted to be limited to the Red Mountain Project, and possibly the Long Lake Hydroelectric Project if the project has an access road within mountain goat habitat. It is assumed that the proposed Bitter Creek Hydro Project will not contribute to the potential mortality risk associated with vehicle collisions, since the project does not propose any access roads within effective mountain goat habitat.

Potential mortality risk associated with improved access for hunters is more difficult to predict because a component of the effect (i.e., the hunter) is outside the control of the proponents. Mitigations to minimize hunting related mortality should minimize the opportunity for hunters to use the new road to access goats in the Bitter Creek watershed.

However, access control measures can be circumvented by determined individuals, and a small number of goats may be killed over multiple years by hunters with unauthorized access.

Characterization of Residual Cumulative Effect

Potential cumulative effects on mortality risk for mountain goats are adverse and result primarily from improved access for hunters. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The magnitude of the effect is predicted to be negligible to low once mitigations (access control) are incorporated. The geographic extent of the effect will be local. The duration of the effects will be long-term for hunter access. The frequency of effects will primarily be regular to continuous, corresponding to road access and vehicle travel along the Project roads. Project effects are anticipated to be partially reversible. Once operations cease, collision risk will no longer be present; however, improved access for hunters may persist after the Project ends. Mountain goats are expected to have a neutral context in terms of sensitivity or resiliency to mortality-related effects because the magnitude of potential effects is estimated to be so low that it will not affect the population.

Likelihood

Low. Chance of increased hunter-related mortality is low if access control is implemented along the Access Road. However, the likelihood of increased hunter-related mortality would increase to high if the access along the Acess Road was not controlled.

Significance

Not significant. The cumulative residual effects of mortality risk for mountain goats were determined to be not significant because the magnitude is negligible to low and the geographic extent local.

Confidence and Risk

High for vehicle collision risk and moderate for increased hunter access risk. Confidence in the prediction is high for vehicle collision risk because mitigations can reduce the magnitude of the effect to a negligible level. Confidence is moderate with respect to controlling hunter access because access control measures can be circumvented by determined individuals. Confidence related to the effect of hunters on mortality is also somewhat reduced because there is uncertainty as to how hunting regulations may be revised to account for the new road. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.2 Residual Cumulative Effects Assessment — Grizzly Bear

Grizzly bear were assessed for potential cumulative effects of habitat availability and mortality risk.

16.8.4.2.1 Habitat Availability

Assessment of habitat availability includes changes as a result of habitat alteration due to clearing and grubbing activities, installation and maintenance of permanent infrastructure (e.g., buildings, roads, transmission lines), and habitat avoidance due to sensory disturbances. Habitat alteration and sensory disturbance was assessed quantitatively for grizzly bear by calculating the area of effective habitat (i.e., habitat rated as being moderately high or high) that overlapped with past, present, and foreseeable future Projects and activities and the ZOI, respectively. The sum of the areas resulted in the total change in habitat availability.

Residual Cumulative Effects Analysis

Grizzly bear habitat availability was assessed through habitat suitability mapping for five grizzly bear life requisites: early spring feeding, late spring feeding, summer feeding, fall feeding, and winter denning.

Approximately 249 ha of the total effective early spring feeding habitat mapped will be altered due to past, present, and future project activities (Table 16.8-5). There is a predicted cumulative change in available habitat of approximately 2% within the RSA where the proposed Project contributes less than 1% change in habitat availability.

Approximately 338 ha of the total effective late spring feeding habitat mapped will be altered due to past, present, and future projects and activities (Table 16.8-5). There is a predicted cumulative change in available habitat of approximately 3% within the RSA, and the proposed Project contributes less than 1% change in habitat availability. The majority of change in effective habitat area has previously occurred or will occur with the Bitter Creek Project.

Approximately 428 ha of the total effective summer feeding habitat mapped will be altered due to past, present, and future project activities (Table 16.8-5). There is a predicted cumulative change in available habitat of approximately 1% within the RSA, and the proposed Project contributes less than 1% change in habitat availability. The majority of the loss of available effective summer feeding habitat is associated with the proposed Project and with the proposed Bitter Creek Project.

Approximately 396 ha of the total effective fall feeding habitat mapped will be altered due to past, present, and future project activities (Table 16.8-5). There is a predicted cumulative change in available habitat of approximately 1% within the RSA, and the proposed Project contributes less than 1% change in habitat availability. The majority of the loss of available effective fall feeding habitat is associated with the proposed Project and with the proposed Bitter Creek Project.

Approximately 11 ha of the total effective winter denning habitat mapped will be altered due to past, present, and future project activities (Table 16.8-5). There is a predicted cumulative change in available habitat of approximately of less than 1% within the RSA, and the majority of the loss of available effective winter denning habitat is associated with the proposed Project.

Overall, the greatest change in type of habitat availability is associated with the loss of late spring feeding habitat (3%). The majority of this loss has already occurred, and the proposed Project contributes less than 1% loss of this type of habitat in the RSA.

Table 16.8-5: Summary of Change in Habitat Availability – Grizzly Bear

Habitat Type	Past, Present, Future (ha)				Project (ha)		Future (ha)		Total Habitat Change (ha)	RSA – Total Habitat (ha)	Cumulative RSA Habitat Change (%)
	Highway 37A	Past and Present Projects[1]	Past, Present, Future Activities	Area of Sensory Disturbance[2]	Red Mountain	Area of Sensory Disturbance	Bitter Creek Hydro Project	Area of Sensory Disturbance			
Early Spring Feeding	<1	18	99	0	42	5	85	0	249	13,858	2
Late Spring Feeding	59	7	111	0	32	8	121	0	338	9,722	3
Summer Feeding	1	9	26	0	82	120	190	0	428	41,428	1
Fall Feeding	1	5	24	0	59	112	194	0	396	27,532	1
Winter Denning	0	<1	2	0	<1	8	<1	0	11	6,496	<1

[1] Long Lake Hydroelectric Project, Stewart Bulk Terminals, Stewart World Port
[2] Area of sensory disturbance includes Hwy 37A and currently operation projects

Characterization of Residual Cumulative Effect

Overall, the proposed Project-related effects on grizzly bear habitat are anticipated to be of minimal concern to the population. Habitat alteration throughout all proposed Project phases are deemed minimal largely because the footprint is small and does not contain large areas of high or moderately-high quality (i.e., effective habitat) feeding or denning habitat for grizzly bear. Grizzly bear may be disturbed by activities in close proximity to effective feeding or denning habitat when Project activities associated with an increase in noise are performed.

The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The cumulative residual effect resulting in changes to grizzly bear habitat availability was assessed as being adverse and at a low to moderate magnitude. This is based on the habitat anlysis and is low (0 to 5%) if changes to habitat types are considered independently but moderate (6 to 15%) if they are added together, which would be a conservative approach because suitable habitat overlaps for different habitat types. The duration of habitat alteration will be long-term, will occur on a continuous basis, will be regional in geographic extent, and is considered reversible upon Project decomssioning and successful reclamation of the Project footprint. Overall, grizzly bear have a high natural resilience to changes in habitat availability and are known to respond and adapt to this effect. This proposed Project does not greatly contribute to the overall loss of grizzly bear habitat availability.

Likelihood

High. A change in habitat availability will occur regardless of the proposed Project mitigation measures that will be implemented to reduce the effect of reduced available habitat. The majority of the change in available habitat has already occurred or will occur in association with the Bitter Creek Hydro Project.

Significance

Not Significant. Habitat availability was considered not significant based on having a low to moderate magnitude, long-term in duration, reversible, and because the project contributes less than 2% change in available habitat in the RSA. The cumulative residual effect of habitat alteration on grizzly bear should not cause any changes to the grizzly bear population found in the area.

Confidence and Risk

Moderate. There is a good understanding of grizzly bear life history requirements. The primary uncertainty is associated with the modeling predictions and the degree of which grizzly bears are actually displaced by project operations within the sensory disturbance zones. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. Grizzly bears will continue to use some portions of the sensory disturbance ZOIs. The ZOI of 500 m was considered a precautionary approach. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.2.2 Mortality Risk

Residual Cumulative Effects Analysis

Roads are considered of particular concern to grizzly bears primarily due to increase human access, which can result in increased mortality due to conflict, hunting pressure, and vehicle collision in addition to habitat-related effects.

While no absolute thresholds have been determined to define a road density that is acceptable to grizzly bears (Ross 2002), roads are known to have a negative effect on grizzly bears when they reach a density of approximately 0.6 km/km^2 (BC MOE 2012). The effect gets stronger once road density increases over approximately 1.0 km/km^2 (BC MOE 2012). Currently, the road density within RSA is 0.04 km/km^2, which is less than the negative threshold effect of 0.6 km/km^2. The Bitter Creek Hydro Project will not increase the road density within the RSA since it will use the same access road as the Red Mountain Project.

Highway 37A, the Long Lake Hydro Project, and the Bitter Creek Hydro Projects are the only other projects in the RSA that could contribute to an increase in human-bear conflict. A completed Traffic Impact Assessment (Appendix 1-C) assessed the amount of existing traffic volume within the RSA to have an average annual daily traffic volume estimated at 256 trips/day for Highway 37A and with a potential 3% increase in daily volume on this highway due to the Red Mountain Project. This same assessment calculated a possible 1% increase in vehicle collisions due to the Red Mountain Project. No specific details on the traffic effect due to the proposed Bitter Creek Hydro Project is currently available, but it is estimated that this project would either have a similar or less of an increase in annual daily traffic volume and less than a one percent increase in vehicle collisions along Highway 37A. No specific details on the traffic effects due to the Long Lake Hydro Project are available, but it is assumed that this information is incorporated into the Highway 37A data.

A study completed in southern Alberta, documented a behavioural response by grizzly bears to road traffic where bears avoided medium (more than 20, and 100 or fewer vehicles per day) and high (more than 100 vehicles per day) volume roads but did use low (20 or fewer vehicles per day) volume roads where available and did cross these roads more frequently (Northrup et al. 2012). Based on the Northrup et al. (2012) study, it is hypothesized that grizzly bears already avoid crossing Highway 37A due to its high traffic volume, which signifies low probability of an increase in grizzly bear mortality risk due to the present and foreseeable future projects.

Characterization of Residual Cumulative Effect

The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. It is expected that the cumulative residual effect of grizzly bear direct mortality due to possible increase in conflict with humans or vehicle collision is adverse and low. Magnitude is low based on the low amount of traffic volume on roads that have a small amount of overlap with available habitat in the RSA and the low risk of conflict considering the Project does not include a camp. The cumulative residual effect is considered low in magnitude and regional in extent. In support of this determination, direct mortality will be long-term in duration, will occur at sporadic intervals, and is reversible after access is closed or reclaimed. Overall, bear populations have good resilience to effects measured by mortality risk and are known to respond and adapt to this effect, a neutral resilience to changes in mortality for the population is considered.

Likelihood

Low, based on the probability that a grizzly bear could be killed as a result of a collision with a vehicle along Highway 37A.

Significance

Not significant. The cumulative residual effect of direct mortality is considered not significant based on having a low magnitude and sporadic frequency. The cumulative effect of direct mortality on grizzly bear should not adversely affect the population found within the RSA.

Confidence and Risk

High. There is a good understanding of grizzly life history requirements as they relate to populations numbers and an approximate density for the overall Grizzly Bear Population Unit is known. The road density in the RSA is known and was compared to a threshold value. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.3 Residual Cumulative Effects Assessment — Moose

Moose were assessed for potential cumulative residual effects of habitat availability and mortality risk.

16.8.4.3.1 Habitat Availability

Assessment of habitat availability includes changes as a result of habitat alteration due to clearing and grubbing activities, construction and maintenance of permanent infrastructure (e.g., buildings, roads, transmission lines), and habitat avoidance due to sensory disturbances. Habitat alteration and sensory disturbance was assessed quantitatively for moose by calculating the area of effective habitat (i.e., habitat rated as being moderately high or high) that overlapped with past, present, and foreseeable future projects or activities and the ZOI, respectively. The sum of the amounts was the total change in habitat availability.

Residual Cumulative Effects Analysis

Approximately 222 ha of the total effective summer living habitat mapped will be altered due to past, present, and future project activities (Table 16.8-6). There is a predicted cumulative change in available habitat of approximately 2% within the RSA, and the proposed Project contributes less than 1% change in habitat availability. The majority of the loss of available effective summer living habitat is associated with the proposed Bitter Creek Hydro Project.

Approximately 84 ha of the total effective winter living habitat mapped will be altered due to past, present, and future project activities (Table 16.8-6). There is a predicted cumulative change in available habitat of approximately 4% within the RSA, and the proposed Project contributes less than 1% change in habitat availability. The majority of the loss of available effective winter living habitat is associated with the proposed Bitter Creek Hydro Project and other disturbance activities.

Table 16.8-6: Summary of Change in Habitat Availability – Moose

Habitat Type	Past, Present, Future (ha)				Project		Future (ha)		Total Habitat Change (ha)	RSA – Total Habitat (ha)	Cumulative RSA Habitat Change (%)
	Highway 37A	Past and Present Projects[1]	Past, Present, Future Activities	Area of Sensory Disturbance[2]	Red Mountain	Area of Sensory Disturbance	Bitter Creek Hydro Project	Area of Sensory Disturbance			
Summer Living	1	9	44	0	24	11	133	0	222	10,076	2
Winter Living	<1	5	24	0	12	2	41	0	84	1,955	4

[1] Long Lake Hydroelectric Project, Stewart Bulk Terminals, Stewart World Port
[2] Area of sensory disturbance includes Hwy 37A and past/present projects

Characterization of Residual Cumulative Effect

The overall Project related cumulative effects on moose habitat are anticipated to be minimal. Habitat alteration throughout all Project phases are deemed minimal largely because the footprint is small and does not contain large areas of high or moderately-high quality winter or summer living habitat for moose. Based on the available habitat calculations it appears that the proposed Bitter Creek Hydro project could potentially have a greater effect on available moose living habitat.

The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. Habitat availability for moose was assessed as being adverse since there will be a loss of habitat and low in magnitude based on the overall amount of habitat subject to change in the RSA. The change in habitat availability has potential to be regional in geographic extent, but the majority of the projected loss will have a local extent due to the location of effective habitat and the project activities. The majority of change to habitat is associated with the Bitter Creek Hydro project, which occurs in the same watershed as the Project. The change in habitat availability is considered to be long-term in duration and to occur on a continuous basis. The effect is considered reversible following the closure and reclamation of projects and activities. Overall, moose have a high natural resilience to habitat availability and are known to respond and adapt to this effect.

Likelihood

High, based on the probability that changes to habitat availability would be caused by the Project, has occurred due to past projects, and has the probability to occur due to future projects.

Significance

Not significant. Changes to habitat availability were considered not significant based on having a low magnitude at the RSA level, local in extent, and reversible in the long term. The effect of Project-related activities on moose habitat availability should not cause any adverse cumulative changes to moose populations in the area.

Confidence and Risk

Moderate. There is a good understanding of moose life history requirements and there is a moderate degree of uncertainty associated with modelling techniques and population data inputs. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.3.2 Mortality Risk

Moose may be killed by vehicles associated with Highway 37A and present and future Projects and activities. Even though no moose or signs of moose were observed during baseline surveys in the Bitter Creek watershed, moose are found throughout the rest of the RSA.

In general, across BC, collisions with moose peak in December and generally occur between 5:00 and 7:00 pm. In the North Coast region approximately 148 moose were involved in vehicle collisions between 2006 and 2010 (O'Keefe and Rea 2012).

Residual Cumulative Effects Analysis

Roads in the RSA currently total approximately 76 km in length. Roads are considered a concern to moose primarily due to increased human access, which can result in increased mortality due to hunting pressure and vehicle collision. No absolute thresholds have been determined to define a road density that is acceptable to moose but it can be assumed that the effect gets stronger as road density increases. Currently, the road density within the RSA is 0.04 km/km^2.

Highway 37A and the Bitter Creek Hydro Project are the only other Projects in the RSA that could contribute to an increase in moose mortality. A completed Traffic Impact Assesssment (Appendix 1-C) assessed the amount of existing traffic volume within the RSA to have an average annual daily traffic volume estimated at 256 trips/day for Highway 37A and with a potential 3% increase in daily volume on this highway due to the Red Mountain Project. This same assessment calculated a possible 1% increase in vehicle collisions (other vehicle and wildlife) due to the Red Mountain Project. No specific details on the traffic effect due to the proposed Bitter Creek Hydro Project is currently available, but it is estimated that this project would either have a similar or less of an increase in annual daily traffic volume and less than a one percent increase in vehicle collisions along Highway 37A. No specific details on the traffic effects due to the Long Lake Hydro Project are available, but it is assumed that this information is incorporated into the Highway 37A data.

Based on currently available information, no new forestry access roads are planned for the RSA and historical logging roads have been deactivated.

Characterization of Residual Cumulative Effect

It is expected that the probability of moose direct mortality due to vehicle collision or from hunting in the RSA is very low based on moose harvest data showing no moose harvested in MU 6-14 since 2011 and currently being closed to moose hunting. The probability of moose direct mortality due to vehicle collision in the RSA is also low, but there will be a possible 1% cumulative increase in overall traffic rates during the Project Operation Phase and another possible 1% increase due to the proposed Bitter Creek Hydro project.

The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5 and described specifically for this assessment above. The cumulative residual effect is considered low in magnitude and regional in extent. In support of this determination, direct mortality will be long-term in duration, will occur at sporadic intervals, and is reversible following closure or reclamation of roads. Overall, a neutral resilience to changes in mortality for the population would be assigned to moose, but since the moose population in this area is currently in a decreasing trend, the characterization is low resilience.

Likelihood

Low based on the probability that a moose could be killed as a result of a collision with a vehicle, especially along Highway 37A, and based on the fact that no moose or sign of moose was observed in the LSA.

Significance

Not significant. The cumulative residual effect of direct mortality is considered not significant based on having a low magnitude and sporadic frequency. The cumulative effect of direct mortality on moose is distinguishable at the individual and not the population level.

Confidence and Risk

Moderate. There is a good understanding of moose life history requirements as they relate to populations numbers, but currently there is not a full understanding of the number of moose potentially found within the RSA. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. Cause-effect relationships between moose populations and land uses are well established; however, currently the driving factors of the multiple-region decreasing trend of moose populations are not well understood. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.4 Residual Cumulative Effects Assessment — Furbearers

Furbearers were assessed for potential cumulative Project-related effects of habitat availability (including habitat alteration and sensory disturbance), disruption to movement (marten), and direct and indirect mortality (marten).

16.8.4.4.1 Habitat Availability

The BC Wildlife Species Inventory database shows marten occurrences within the eastern portion of the RSA along the White River, Nelson, and Surprise Creek drainages.

Residual Cumulative Effects Analysis — Marten

Approximately 125 ha of effective winter living habitat will be altered due to past, present, and future project activities (Table 16.8-7). Effective winter living habitat will be reduced by less than 1% in the RSA. The majority of the loss of available effective winter living habitat is associated with the proposed Project (47 ha) and the Bitter Creek Hydro project (61 ha).

Table 16.8-7: Summary of Change in Habitat Availability — Marten

Habitat Type	Past, Present, Future (ha)				Project (ha)		Future (ha)		Total Habitat Change (ha)	RSA – Total Habitat (ha)	Cumulative RSA Habitat Change (%)
	Highway 37A	Past and Present Projects[1]	Past, Present, Future Activities	Area of Sensory Disturbance[2]	Red Mountain	Area of Sensory Disturbance	Bitter Creek Hydro Project	Area of Sensory Disturbance			
Winter Living	<1	1	15	0	13	34	61	0	125	21,175	<1

[1] Long Lake Hydroelectric Project, Stewart Bulk Terminals, Stewart World Port
[2] Area of sensory disturbance includes Hwy 37A and past/present projects

Characterization of Cumulative Residual Effect

The cumulative residual effect is expected to have an adverse effect on marten habitat through habitat alteration and sensory disturbance. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. This effect will be low magnitude based on the amount of habitat subject to change (less than 1%). The geographic extent of the effect is expected to be local since the majority of the loss of habitat occurs within the Bitter Creek watershed. Habitat loss is expected to be long-term in duration, occurring on a continuous basis, and reversible following closure and reclamation of projects and activities. Context is considered high since marten can respond and adapt to habitat availability effects and the majority of the population has been observed outside of the Bitter Creek watershed.

Likelihood

High, since approximately 16 ha of available effective winter living habitat has already been removed due to past projects, and more than 100 ha of effective winter living habitat could be loss due to present and future project activities.

Significance

Not significant. While discrete effects may occur, effects do not pose risk to long-term persistence and viability of marten within the RSA. Studies have shown changes to marten home range location and size associated with forest development especially in areas where greater than 25% of marten habitat was modified (Leiffers and Woodward 1997; Hargis et al. 1999; Chapin et al. 1999). In the Hargis and Bissonette (1997) study, it was demonstrated that marten may abandon an area, even high-quality habitat areas or areas of low fragmentation, when habitat modifications exceeded 25%. The past, present, and future projects within the RSA will not approach this threshold.

Confidence and Risk

High. There is a good understanding of required marten living habitat. There is a low degree of uncertainty associated with the baseline data and modeling results. Mitigation measures were considered to have some effectiveness in minimizing potential effects on habitat loss. There is very low risk that the Project effects could exceed those used in this assessment and more than likely, the effects will be less than those used in this assessment. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

Residual Cumulative Effects Analysis — Wolverine

Approximately 765 ha of effective growing living habitat will be altered due to past, present, and future project activities (Table 16.8-8). Effective growing living habitat will be reduced by 1% in the RSA. Approximately 96 ha of effective winter denning habitat will be altered due to past, present, and future project activities (Table 16.8-8). Effective winter denning habitat will be reduced by less than 1% in the RSA.

Table 16.8-8: Summary of Change in Habitat Availability — Wolverine

Habitat Type	Past, Present, Future (ha)				Project (ha)		Future (ha)		Total Habitat Change (ha)	RSA – Total Habitat (ha)	Cumulative RSA Habitat Change (%)
	Highway 37A	Past and Present Projects [1]	Past, Present, Future Activities	Area of Sensory Disturbance [2]	Red Mountain	Area of Sensory Disturbance	Bitter Creek Hydro Project	Area of Sensory Disturbance			
Growing Living	1	20	80	0	117	343	204	0	765	59,311	1
Winter Denning	<1	<1	6	0	13	34	42	0	96	10,906	<1

[1] Long Lake Hydroelectric Project, Stewart Bulk Terminals, Stewart World Port
[2] Area of sensory disturbance includes Hwy 37A and past/present projects

Characterization of Cumulative Residual Effect

The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The cumulative residual effect is expected to be adverse and low to moderate in magnitude. The geographic extent of the effect is expected to be regional but the majority of the effect will occur at the local level. The cumulative effect on habitat availability is expected to be long-term duration, occurring on a continuous basis, and reversible depending on project decommissioning and successful reclamation. The context is considered high.

Likelihood

Moderate based on the assumption that there will be a reduction to habitat availability and that wolverine habitat modelling was largely based on where prey is available, which includes a wide range of habitat characteristics. Habitat modelling for wolverine is limited in its ability to predict the spatial location of the most effective habitat for the species.

Significance

Not significant. While discrete effects may occur, effects do not pose risk to long-term persistence and viability of wolverine populations within the RSA. The majority of the cumulative effects are limited to the Bitter Creek valley.

Confidence and Risk

Moderate. There is somewhat of a good understanding of required wolverine living habitat. There is uncertainty associated with the amount of available prey species within the RSA and the limited baseline data, which is normal relative to the life cycle and elusive nature of this species. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. Mitigation measures were considered to have a low effectiveness in minimizing potential effects on habitat availability. There is a low risk the effects will exceed the predicted magnitude and it is more likely the ZOI (500 m) overestimate the change to habitat availability. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.4.2 Habitat Distribution — Marten

Martens are solitary except during the breeding season. Home range sizes are variable depending on geographic location, available habitat types, and prey abundance. It is estimated that in BC, marten have an average home range size of about 5 km^2 for males and 2 to 3 km^2 for females (Hatler et al. 2003). Early seral stage and large treeless tracts have the potential to act as barriers to marten movement (Gibilisco 1994; Hawley and Newby 1957).

Residual Cumulative Effects Analysis

Snow tracking surveys comparing marten response to roads indicated that marten were as likely to be found near roads as away from roads, but tracks were more clumped away from roads suggesting that movement patterns and habitat use differed near roads (Robitaille and Aubry 2000). This could suggest that marten avoid areas that are more open (lack overhead cover), such as roads and forest edges. Bissonette and Sherburne (1993) demonstrated that marten typically do not readily cross open areas wider than 100 m.

High-quality marten habitat exists on both sides of the proposed Project Access Road, starting from the turn off at Highway 37A (Stewart Highway) to Bromley Humps and the Process Plant. The Bitter Creek Hydro project proposed access road will overlap the Project Access Road. This access road runs adjacent to Bitter Creek, which does provide a natural barrier to marten movement within these large patches of high quality marten winter habitat. Marten may travel across Bitter Creek in areas where natural bridges, such as fallen trees, cross the creek. Literature does state that marten will not readily cross open areas wider than 100 m, and the road ROW will be below this threshold.

Currently, no new access roads are proposed elsewhere in the RSA. The majority of the cumulative effect to habitat distribution for marten is predicted to occur within the LSA.

Characterization of Cumulative Residual Effect

The cumulative residual effect is expected to have an adverse effect on marten habitat distribution. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. This effect will be low magnitude based on the low amount of new disturbance and low amount of overlap with available habitat in context of the habitat available in the RSA. The geographic extent of the effect is expected to be local since the majority of the effect on habitat distribution is within the Bitter Creek watershed. Habitat distribution is expected to be long-term in duration, occurring on a sporadic basis, and reversible following closure and reclamation of projects and activities. Context is considered high since marten can respond and adapt to habitat availability effects, and the majority of the population has been observed outside of the Bitter Creek watershed.

Likelihood

Low since the road ROW is below the threshold limit of 100 m, the proposed Bitter Creek Hydro project will be using the same access road, and portions of high quality winter habitat are currently naturally fragmented by Bitter Creek.

Significance

Not significant. The cumulative residual effects will be localized to the Bitter Creek watershed. The access road will be less than 100 m wide. Marten have been known to use drainage culverts to access habitats on either side of roads (Clevenger et al. 2001).

Confidence and Risk

High. Existing studies provide good information on how linear features could potentially affect marten movement patterns. There is a moderate degree of uncertainty associated with the modeling results. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.4.3 Mortality Risk — Marten

Direct mortality of marten has the potential to occur as a result of vegetation clearing and vehicle collisions along roads with the RSA.

Residual Cumulative Effects Analysis

Direct mortality to marten from vehicle collisions is expected be infrequent, since marten are known to avoid areas that lack overhead cover and roads (Poole et al. 2004). This statement is supported by mortality records of marten along highways. The Bulkley-Stikine District mortality records database lists three vehicle-marten collisions occurring between 1983 and 2007 (Sielecki 2004, 2010) and in Banff National Park, marten were part of the 2% of small vertebrate road kills (Clevenger et al. 2003).

Incidental mortality of females and their young could occur during any clearing of vegetation during marten birthing and rearing periods. Typically maternal dens can be found within large spruce trees or cottonwoods or hollow logs. In general, young are born in late March, and mothers may move young to a second maternal den site (Powell et al. 2003). The young are often able to leave the den site in late spring (Ruggiero et al. 1994).

Characterization of Cumulative Residual Effect

The Project is expected to have an adverse effect on marten direct mortality. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The effect was considered to have a low magnitude. This was based on the low traffic volumes and low amount of new disturbance both of which interact with a low amount of habitat in context of the habitat available in the RSA. The geographic extent of the effect is expected to be local since most of the potential effects will occur within the Bitter Creek watershed, and is expected to be long-term in duration. This effect has a sporadic frequency and is considered reversible following closure and reclamation of projects and activities. Context is considered neutral.

Likelihood

Low, since vehicle collision with marten and the destruction of an active maternal den has a low probability of occurring and is potentially be limited to the Bitter Creek watershed and not throughout the RSA.

Significance

Not significant. This effect is not considered to be cumulative because the magnitude is low and the possible effect of direct mortality to marten is limited to the Bitter Creek watershed and not throughout the RSA.

Confidence and Risk

High. The probability of marten being killed due to vehicle collision or vegetation clearing is considered very low based on available information. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.5 Residual Cumulative Effects Assessment — Hoary Marmot

Hoary marmots were assessed for potential cumulative residual effects of habitat alteration and direct mortality. Sensory disturbance was determined to have no interaction with hoary marmots, as this species frequently habituates to human disturbance. Similar to the effects assessment for the Project, the spatial boundary for the CEA was selected as the LSA.

16.8.4.5.1 Habitat Availability

Assessment of habitat availability includes changes as a result of habitat alteration due to clearing and grubbing activities, construction, and maintenance of permanent infrastructure (e.g., buildings, roads, transmission lines). Habitat alteration was assessed quantitatively for hoary marmot by calculating the area of effective habitat (i.e., habitat rated as being moderately high or high) that overlapped with past, present, and foreseeable future projects or activities. The sum of the amounts was the total change in habitat availability.

Residual Cumulative Effects Analysis

Approximately 31 ha of the total effective summer living habitat mapped will be altered due to past, present, and future project activities (Table 16.8-9). There is a predicted cumulative change in available habitat of approximately 5% within the LSA. The majority of the loss of available effective summer living habitat is associated with the Project.

Table 16.8-9: Summary of Change in Habitat Availability — Hoary Marmot

Habitat Type	Past, Present, Future (ha)				Project (ha)		Future (ha)		Total Habitat Change (ha)	LSA – Total Habitat (ha)	Cumulative LSA Habitat Change (%)
	Highway 37A	Past and Present Projects[1]	Past, Present, Future Activities	Area of Sensory Disturbance[2]	Red Mountain	Area of Sensory Disturbance	Bitter Creek Hydro Project	Area of Sensory Disturbance			
Summer Living	0	0	<1	0	31	0	0	0	31	684	5

[1] Long Lake Hydroelectric Project, Stewart Bulk Terminals, Stewart World Port
[2] Area of sensory disturbance includes Hwy 37A and past/present projects

Characterization of Residual Cumulative Effect

The Project is expected to have an adverse effect on hoary marmot habitat through habitat alteration. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. This effect was considered to have a low magnitude (5% habitat change). The geographic extent of the effect is expected to be local within the LSA, with most of the change associated with the Project within the Goldslide Creek basin. Hoary marmots have small home ranges (less than 14 ha) and typically forage within 200 to 300 m of their burrows (RIC 1998d). Habitat loss and alteration is expected to be long-term in duration, continuous in frequency, and reversible once successful reclamation has occurred and project activities cease. Context is considered neutral.

Likelihood

High, since approximately 31 ha of available summer living habitat could be lost due to present Project activities.

Significance

Not significant. Cumulative residual effects on habitat availability are considered not significant because any residual effect will have a low magnitude, a local extent, and be reversible. Based on these criteria it is unlikely that the cumulative effects will have a measurable effect on the size or viability of the hoary marmot population within the LSA.

Confidence and Risk

Moderate. A precautionary approach was taken during the assessment. Modeled WHRs correlated well with observations of hoary marmot individuals and sign. In addition, mitigation measures were considered moderately effective in minimizing potential effects on habitat loss or alteration. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.5.2 Mortality Risk

Residual Cumulative Effects Analysis

Direct mortality on hoary marmot within the LSA was evaluated as a potential residual cumulative effect. During baseline studies for the Project, hoary marmots and sign were observed in talus slopes and alpine heather meadows, corresponding with moderate to high habitat ratings. Individuals and burrows were observed in the Goldslide Creek basin above the existing exploration camp and adjacent to the mine Haul Road. Direct mortality could occur as a result of dens being located within the footprints of past, present, or foreseeable future projects or activities within the LSA. Vehicle collisions along the Access Road within the LSA may also result in direct morality.

Characterization of Residual Cumulative Effect

The effect of direct morality is expected to be a cumulative residual effect, since hoary marmots could suffer direct morality if their dens are located within the footprints of past, present, or foreseeable future projects or activities. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. This effect was considered to have a moderate magnitude since dens are located immediately adjacent to the proposed Haul Road for the Project. The geographic extent of the effect is expected to be local within the LSA, with most of the risk associated with the Project within the Goldslide Creek basin. Hoary marmots have small home ranges (less than 14 ha) and typically forage within 200 to 300 m of their burrows (RIC 1998d). Effects of direct morality are expected to be long-term in duration, sporadic in frequency, and reversible once project activities cease. Context is considered neutral.

Likelihood

Moderate. While baseline conditions represent incidental observations and additional denning sites may be present within the footprints of past, present, and foreseeable future projects or activities, effective mitigation measures, such as minimizing habitat disturbance through establishment of no-disturbance buffers surrounding sensitive habitat features (i.e., den sites), will be implemented. Mitigation measures will also address vehicle traffic; for example, minimizing project traffic and reducing speed limits.

Significance

Not significant. Cumulative residual effects on habitat availability are considered not significant because any residual effect will be sporadic in frequency, have a moderate magnitude, a local extent, and be reversible. Based on these criteria it is unlikely that cumulative effects will have a measurable effect on the size or viability of the hoary marmot population within the LSA.

Confidence and Risk

Moderate. A precautionary approach was taken during the assessment. The habitat preferences of hoary marmot are well known. Baseline information included a habitat model and field surveys. In addition, mitigation measures are established, have been used before, and were considered effective in minimizing potential effects on direct mortality. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.6 Residual Cumulative Effects Assessment — Bats

Bats were assessed for potential cumulative residual effects of habitat alteration. Sensory disturbance was determined to have no interaction with bats. Similar to the effects assessment for the Project, the spatial boundary for the CEA was selected as the LSA rather than the RSA due to the small home range sizes of bats relative to other wildlife VCs.

16.8.4.6.1 Habitat Availability

Assessment of habitat availability includes changes as a result of habitat alteration due to clearing and grubbing activities, construction, and maintenance of permanent infrastructure (e.g., buildings, roads, transmission lines). Habitat alteration was assessed quantitatively for bats by calculating the area of effective habitat (i.e., habitat rated as being moderately high or high) that overlapped with past, present, and foreseeable future projects or activities. The sum of the amounts was the total change in habitat availability.

Residual Cumulative Effects Analysis

Approximately 306 ha of the total effective growing living habitat mapped will be altered due to past, present, and future project activities (Table 16.8-10). There is a predicted cumulative change in available habitat of approximately 11% within the LSA. The majority of the loss of available effective growing living habitat is associated with the Project and the future Bitter Creek Hydro Project.

Table 16.8-10: Summary of Change in Habitat Availability — Bats

Habitat Type	Past, Present, Future (ha)				Project (ha)		Future (ha)		Total Habitat Change (ha)	LSA – Total Habitat (ha)	Cumulative LSA Habitat Change (%)
	Highway 37A	Past and Present Projects[1]	Past, Present, Future Activities	Area of Sensory Disturbance[2]	Red Mountain	Area of Sensory Disturbance	Bitter Creek Hydro Project	Area of Sensory Disturbance			
Growing Living	<1	0	4	0	47	199	56	0	306	2,893	11

[1] Long Lake Hydroelectric Project, Stewart Bulk Terminals, Stewart World Port
[2] Area of sensory disturbance includes Hwy 37A and past/present projects

Characterization of Residual Cumulative Effect

Cumulative effects are expected to have an adverse effect on bat habitat through habitat alteration. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. This effect is considered to have a moderate magnitude based on the analysis of habitat change. Loss of 306 ha of habitat is not likely to affect local populations. The carrying capacity of the landscape for bats is therefore unlikely to be affected by habitat loss given the large amount of habitat potentially available in the LSA. The geographic extent of the effect is expected to be local within the LSA, with most of the change associated with the Project and the future Bitter Creek Hydro Project. Habitat alteration is expected to be long-term in duration, continuous in frequency, and reversible once successful reclamation has occurred and project activities cease. Context is considered high. Bats in this area should have a high resiliency to change given bats' tendency to use multiple tree roosts in a season, and it is likely that bats will locate alternate tree roosts after clearing.

Likelihood

High. Reduction of habitat availability is entirely due to direct habitat alteration, which is certain to result in a reduction of preferred roosting habitat for bats located within the Project footprint and the footprint of the future Bitter Creek Hydro Project.

Significance

Not significant. The cumulative residual effect of habitat alteration is considered not significant based on having a low magnitude for suitable growing living habitat, being local in extent, long-term in duration, and reversible. Given the distances moved between roosts and the availability of useable habitat within the LSA, bats should be able to exploit alternate roosts located outside the relatively small footprint areas.

Confidence and Risk

Moderate. There is good understanding of bat life history requirements for the species that may be present; however, there is limited information as to their use of this area and there is a moderate degree of uncertainty associated with modelling techniques and area abundance. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.7 Residual Cumulative Effects Assessment — Migratory Breeding Birds

16.8.4.7.1 Habitat Availability – Bird Guilds

Habitat availability includes changes to the amount or quality of effective nesting habitat by habitat guild (i.e., habitat rated as suitable) as a result of habitat alteration or sensory disturbance. Habitat alteration was assessed quantitatively for migratory breeding bird species within the RSA by calculating the amount of effective nesting habitat that overlapped with past, present, and future projects. Sensory disturbance was assessed quantitatively within the RSA by calculating the amount of effective nesting habitat that overlapped within the ZOI.

Residual Cumulative Effects Analysis

The habitat assessment indicated that approximately 188 ha of effective alpine habitat, 1,193 ha of effective old/mature forest habitat, 619 ha of effective riparian habitat, and 1,405 ha of effective shrub/early successional habitat may be lost or altered due to past, present, and future Projects (Table 16.8-11). This represents a less than 1% loss of effective alpine habitat within the RSA, a 3% loss of effective old/mature forest and shrub/early successional habitat within the RSA, and a 5% loss of effective riparian habitat within the RSA.

Table 16.8-11: Summary of Change in Habitat Availability — Bird Guilds

Habitat Type	Past, Present, Future (ha)				Project (ha)		Future (ha)		Total Habitat Change (ha)	RSA – Total Habitat (ha)	Cumulative RSA Habitat Change (%)
	Highway 37A	Past and Present Projects [1]	Past, Present, Future Activities	Area of Sensory Disturbance [2]	Red Mountain	Area of Sensory Disturbance	Bitter Creek Hydro Project	Area of Sensory Disturbance			
Alpine	0	8	7	18	45	109	0	0	188	34,653	<1
Old/Mature Forest	<1	4	59	578	67	145	169	171	1,193	34,249	3
Riparian	<1	2	22	307	47	72	101	67	619	12,146	5
Shrub/Early Successional	<1	27	128	634	106	159	210	141	1,405	49,889	3

[1] Long Lake Hydroelectric Project, Stewart Bulk Terminals, Stewart World Port
[2] Area of sensory disturbance includes Hwy 37A and past/present projects

Characterization of Cumulative Residual Effect

Past, present, and future projects are expected to have an adverse effect on the effective nesting habitat of migratory breeding birds related to habitat alteration and sensory disturbance. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The combined effects are considered to have a low magnitude at the RSA level, as less than 1% of the effective RSA nesting habitat will be directly or indirectly affected by past, present, and future project activities. The geographic extent of the combined effects is expected to be regional. Habitat alteration and sensory disturbance are expected to be long-term in duration. Habitat availability will occur continuously and is considered reversible once reclamation has been successfully completed and project activities have stopped. Context is considered high because, in general, the assessed migratory bird species have high natural resilience to imposed stresses and can respond and adapt to the effect, especially given the amount of available habitat within the RSA.

Likelihood

High, because effective nesting habitat availability overlaps with past, present, and future project footprints.

Significance

Not significant. The residual effects of habitat availability is assessed as to be not significant at the RSA level for migratory breeding birds based on the low magnitude, long-term duration, and regular occurrence. These species are also considered to have high resilience to changes in habitat availability.

Confidence and Risk

Moderate. The primary uncertainty associated with this prediction is the degree to which migratory breeding birds are actually displaced by mining operations within the sensory disturbance zones, resulting in reduced habitat. Further uncertainty is related to how well the habitat guilds reflect actual habitat use by migratory breeding birds within the RSA. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. The assumptions used in this assessment are precautionary, both in terms of the sizes of the disturbance ZOIs and magnitude of effect (i.e., complete loss of habitat), and likely overestimate potential Project effects on habitat availability. There is very low risk that the Project effects could exceed those used in this assessment. More likely, migratory breeding birds will continue to use some portions of the sensory disturbance ZOIs and the effects will be less than those used in this assessment. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.7.2 Habitat Availability — MacGillivray's Warbler

Residual Cumulative Effects Analysis

Approximately 428 ha of effective MacGillivray’s warbler nesting habitat will be altered due to past, present and future projects within the RSA (Table 16.8-12). This represents a 2% change in effective nesting habitat for MacGillivray’s warbler within the RSA.

Table 16.8-12: Summary of Change in Habitat Availability — MacGillivray’s Warbler

Habitat Type	Past, Present, Future (ha)				Project (ha)		Future (ha)		Total Habitat Change (ha)	RSA – Total Habitat (ha)	Cumulative RSA Habitat Change (%)
	Highway 37A	Past and Present Projects[1]	Past, Present, Future Activities	Area of Sensory Disturbance[2]	Red Mountain	Area of Sensory Disturbance	Bitter Creek Hydro Project	Area of Sensory Disturbance			
Nesting	<1	9	54	48	62	87	133	35	428	23,805	2

[1] Long Lake Hydroelectric Project, Stewart Bulk Terminals, Stewart World Port
[2] Area of sensory disturbance includes Hwy 37A and past/present projects

Characterization of Cumulative Residual Effect

Past, present, and future projects are expected to have an adverse effect on the effective nesting habitat for MacGillivray’s warbler related to habitat alteration and sensory disturbance. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The magnitude of the cumulative effects to habitat availability was rated low because 2% of the effective habitat within the RSA will be affected by past, present, and future projects. The geographical extent of effects on habitat availability for MacGillivray's warbler will be regional. The duration of cumulative effects on habitat availability will be long-term. Because MacGillivray's warblers use early successional habitat, habitat suitability will return relatively quickly for this species. The area affected by sensory disturbance should return to the original habitat effectiveness following closure and reclamation of projects and activities. Effects on habitat availability are considered reversible, as most effected habitat will recover once sensory disturbance ceases and remaining altered habitat will recover following site reclamation. Cumulative effects on habitat availability will occur on a continuous basis.

Context for MacGillivray's warbler is rated as high. This species uses early successional habitat for nesting and foraging. Human activity that creates early successional habitat, such as logging and mineral exploration, is thought to have increased habitat availability for this species (Nitschke 2008; Pitocchelli 2013).

Likelihood

High, because effective habitat will overlap with the Project footprint and with past and future projects.

Significance

Not significant. Residual effects are considered to be not significant since they will have a low magnitude and will be reversible. MacGillivray's warblers are considered to have high resilience to changes in habitat availability. Based on these criteria, it is unlikely that the Project will have a measurable effect on the size or viability of the MacGillivray's warbler population within the RSA.

Confidence and Risk

High. There is a good understanding of the cause-effect relationship between the Project and MacGillivray's warbler habitat availability. The primary uncertainty is in how far habitat effects from sensory will extend beyond the Project footprint. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. The 150 m ZOI around projects likely overestimates potential effects on habitat availability. There is very low risk that the effects could exceed those used in this assessment. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.8 Residual Cumulative Effects Assessment — Migratory Birds Species at Risk

This section describes residual effects identified with migratory birds that are at risk provincially and/or federally. This includes black swift, common nighthawk, marbled murrelet, and olive-sided flycatcher.

Potential residual effects to migratory bird species at risk include habitat availability and mortality risk. The residual effect, mortality risk, is predicted to have a potential cumulative effect only on common nighthawk and marbled murrelet.

16.8.4.8.1 Habitat Availability — Black Swift

Habitat availability for black swift includes changes to the amount or quality of effective nesting as a result of habitat alteration or sensory disturbance. Habitat alteration was assessed quantitatively within the RSA by calculating the area of effective nesting habitat that overlapped with the past, present, and future project and activity footprints. Sensory disturbance was assessed quantitatively within the RSA by calculating how much effective nesting habitat overlapped within the ZOI. The ZOI was calculated using the same methodology as the Project effects assessment.

Residual Cumulative Effects Analysis

The cumulative residual effects assessment indicates that 77 ha of effective nesting habitat may be lost or altered due past, present, and future project activities (Table 16.8-13). This represents a 4% loss of effective habitat within the RSA due to past, present, and future projects whereas the Project represents the greatest loss of effective habitat within the RSA (3%).

Table 16.8-13: Summary of Change in Habitat Availability — Black Swift

Habitat Type	Past, Present, Future (ha)				Project (ha)		Future (ha)		Total Habitat Change (ha)	RSA – Total Habitat (ha)	Cumulative RSA Habitat Change (%)
	Highway 37A	Past and Present Projects [1]	Past, Present, Future Activities	Area of Sensory Disturbance [2]	Red Mountain	Area of Sensory Disturbance	Bitter Creek Hydro Project	Area of Sensory Disturbance			
Nesting	<1	2	4	4	5	46	11	5	77	2,084	4

[1] Long Lake Hydroelectric Project, Stewart Bulk Terminals, Stewart World Port
[2] Area of sensory disturbance includes Hwy 37A and past/present projects

Characterization of Cumulative Residual Effect

Past, present, and future projects are expected to have an adverse effect on black swift effective nesting habitat due to habitat alteration and sensory disturbance. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The combined effects are considered to have a low magnitude at the RSA level, as a maximum of 4% of the effective RSA nesting habitat will be directly or indirectly affected. The geographic extent of the combined effects is expected to be mostly local due to the majority of the altered habitat is within the LSA, but some habitat loss is at a regional level. Habitat alteration and sensory disturbance are expected to be long-term in duration. Habitat alteration is considered partially reversible following reclamation, depending on the type alteration, due to the highly specific nest site attributes required by black swifts. Sensory disturbance will occur continuously but is considered reversible once activities cease. Context is considered low because black swift are a species at risk in Canada that require highly specific nest site attributes and have a very high nest-site fidelity (Campbell et al. 1990). Black swift may not be able to respond and adapt to adverse nesting habitat effects as readily as other migratory bird species.

Likelihood

Moderate as this species was observed in the LSA and assumed to also occur in the RSA. The combined Project footprint and ZOI will overlap with modelled effective nesting habitat for this species. There is no confirmation of nesting habitat within the LSA.

Significance

Not significant. The combined residual effects of habitat alteration and sensory disturbance are assessed to be not significant for black swift based on a low magnitude, long-term duration, and regular occurrence. Habitat alteration and sensory disturbance will result in a greater than negligible adverse effect within the LSA but not at the RSA level. The effect is considered partially reversible and it is unlikely that these effects would pose a risk to the long-term persistence and viability of black swift at the regional level.

Confidence and Risk

Moderate. There is reasonable confidence in the cumulative effects assessment conclusions for habitat alteration and sensory disturbance on black swift. The cause-effect relationships between the past, present, and future projects and black swift are understood. Black swift is difficult to detect and nests have rarely been found; however, a standard for habitat modelling was used and the approach to assessing effects based on modelling habitat is well established. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.8.2 Habitat Availability – Common Nighthawk

Habitat availability for common nighthawk includes changes to the amount or quality of effective nesting habitat (i.e., habitat rated as high or moderate suitability) as a result of habitat alteration or sensory disturbance. Habitat alteration was assessed quantitatively within the RSA by calculating the area of effective nesting habitat that overlapped with past, present, and future project footprints. Sensory disturbance was assessed quantitatively within the RSA by calculating how much effective nesting habitat overlapped with the ZOI. The same ZOI methodology used in the Project-related effects assessment was used.

The Recovery Strategy for common nighthawk identified loss or degradation of nesting habitat due to clearing as an unknown severity threat with a low casual certainty (EC 2016a). The recovery strategy also identified reduced availability of insect prey due to loss of insect-producing habitats (i.e., waterbodies) as a moderate severity threat with a medium casual certainty (EC 2016a). Severity reflects the population-level effect of a specific threat and causal certainty reflects the degree of known evidence to support the assessment of a specific threat (EC 2016a). Medium causal certainty indicates a correlation between the threat and population viability whereas low causal certainty indicates the threat is plausible (EC 2016a).

Residual Cumulative Effects Analysis

The cumulative residual effect habitat assessment indicated that 233 ha of effective nesting habitat for common nighthawk may be adversely affected due to habitat alteration and sensory disturbance (Table 16.8-14). This represents a 5% loss of effective nesting habitat within the RSA due to past, present, and future project activities. The proposed Project represents a less than 1% loss of effective nesting habitat and does not appear to contribute to a cumulative loss of effective nesting habitat.

Table 16.8-14: Summary of Change in Habitat Availability — Common Nighthawk

Habitat Type	Past, Present, Future (ha)				Project (ha)		Future (ha)		Total Habitat Change (ha)	RSA – Total Habitat (ha)	Cumulative RSA Habitat Change (%)
	Highway 37A	Past and Present Projects[1]	Past, Present, Future Activities	Area of Sensory Disturbance[2]	Red Mountain	Area of Sensory Disturbance	Bitter Creek Hydro Project	Area of Sensory Disturbance			
Nesting	<1	17	27	128	<1	7	53	2	233	4,823	5

[1] Long Lake Hydroelectric Project, Stewart Bulk Terminals, Stewart World Port
[2] Area of sensory disturbance includes Hwy 37A and past/present projects

Characterization of Cumulative Residual Effect

Past, present, and future project activities are expected to have an adverse effect on common nighthawk effective nesting habitat due to habitat alteration and sensory disturbance. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The combined effects are considered to have a low magnitude within the context of the RSA because 5% of effective nesting habitat will be directly or indirectly affected by the combined project footprints and ZOI. The geographic extent of the combined effects is expected to be regional. Habitat alteration and sensory disturbance are expected to be long-term in duration. Habitat availability will occur continuously and is considered reversible following reclamation.

Context is considered low because common nighthawks are a species at risk in Canada that are sensitive to changes in their environment (EC 2016a). It is speculated that an available and constant supply of flying insects is likely the most limiting factor for the species survival (Campbell et al. 2006). Common nighthawks also have a short breeding season that limits them to one brood per season, and clutch size is small (i.e., average two eggs; Campbell et al. 2006; EC 2016a). Therefore, common nighthawks may not be able to respond and adapt to adverse nesting habitat effects as readily as other migratory bird species.

Likelihood

Low because the combined Project footprint and ZOI contribute a less than 1% change in habitat availability at the RSA level. Past and future projects overlap with modelled effective nesting habitat for this species, and three nighthawks were observed along Highway 37A.

Significance

Not significant. The combined residual effects of habitat alteration and sensory disturbance are not significant to common nighthawk nesting habitat based on low magnitude and regional geographic extent. Although habitat alteration and sensory disturbance may result in a greater than negligible adverse effect within the RSA, it is unlikely that Project related effects would pose a risk to the long-term persistence and viability of common nighthawks at the regional level.

Confidence and Risk

Moderate. A habitat model based on well-known habitat requirements for the species was completed in the RSA, and the model outputs correlated well with the field observations. However this is moderated by a limited amount of data on the species occurrence in the Project area. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. The risk of the effects being greater than predicted is low. Mitigation measures are established that have been used effectively on other projects. The Project footprint will be minimized and existing roads will be used to the greatest extent practicable, which will minimize habitat alteration for common nighthawks. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.8.3 Habitat Availability – Marbled Murrelet

Habitat availability for marbled murrelet includes direct and indirect effects to effective breeding habitat. Effective habitat is defined as the sum of class 1 (very high), 2 (high), and 3 (moderate) rated habitat. Class 3 habitat is included as suitable habitat for marbled murrelet since the accepted Provincial standards describe it as “nesting likely but at moderate to low densities” (Burger 2004).

Indirect effects include indirect habitat alteration adjacent to vegetation clearing that result from edge effects, such as increased insolation and exposure to wind. These effects have been identified as occurring up to about 140 m from “hard” edges (i.e., those with a dramatic change in structure, such as old-growth forest adjacent to a recent clearing [e.g., Chen et al. 1992, Voller 1998]), but can extend as far as 240 m in extreme circumstances, for example an old-growth forest edge exposed to extreme heat and wind on a southern exposure (Chen 1991).

As a result of these potential indirect effects, a ZOI of 300 m has been used to estimate potential indirect effects to marbled murrelet nesting habitat. This is considered a conservative estimate and is more likely to over-estimate rather than under-estimate indirect project effects.

The cumulative assessment of effects on marbled murrelet habitat used the products of two different models and followed the same methodology that was used for the Project-related effects assessment.

Residual Cumulative Effects Analysis

According to the TEM/PEM model, past, present, and future effects include a total habitat change of 382 ha, representing a loss of 13% of effective nesting habitat in the RSA (Table 16.8-15). The BC Model shows substantially less effective nesting habitat loss within the RSA due to past, present, and future Project activities (i.e., less than 1% in the RSA).

According to the results of the TEM/PEM model and BC model, past, present, and future activities may adversely affect less than 1% of the habitat in excess of the minimum habitat retention level for marbled murrelet in the Northern Mainland Coast conservation region as of 2011 (i.e., 127,570 ha). Therefore, the cumulative effects of past, present, and future activities on suitable nesting habitat for marbled murrelet are not likely to compromise the minimum habitat retention level for the Northern Mainland Coast conservation region.

Table 16.8-15: Summary of Change in Habitat Availability — Marbled Murrelet

Habitat Type	Past, Present, Future (ha)				Project (ha)		Future (ha)		Total Habitat Change (ha)	RSA – Total Habitat (ha)	Cumulative RSA Habitat Change (%)
	Highway 37A	Past and Present Projects [1]	Past, Present, Future Activities	Area of Sensory Disturbance [2]	Red Mountain	Area of Sensory Disturbance	Bitter Creek Hydro Project	Area of Sensory Disturbance			
TEM/PEM Model	<1	<1	11	250	3	54	40	23	382	2,971	13
BC Model	<1	0	<1	0	0	0	0	0	<1	<1	<1

[1] Long Lake Hydroelectric Project, Stewart Bulk Terminals, Stewart World Port
[2] Area of sensory disturbance includes Hwy 37A and past/present projects

Characterization of Cumulative Residual Effect

Past, present, and future project activities are expected to have an adverse effect on marbled murrelet effective nesting habitat. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The combined effects are considered to potentially have a moderate magnitude within the context of the RSA since less than 15% of available habitat will be altered based on the TEM/PEM habitat model. The geographic extent of the combined effects will be regional. Habitat alteration will be long-term in duration. Habitat alteration is considered permanent within the temporal scale of the projects. The effect is expected to occur continuously and be reversible based on successful reclamation.

Context is considered moderate because marbled murrelet are a species at risk in Canada and may not be able to respond and adapt to adverse nesting habitat effects as readily as other migratory bird species.

Likelihood

Low. Effective habitat will be altered but local populations are not well understood. If regional populations are very low, habitat is not expected to be a limiting resource.

Significance

Not Significant. The combined residual effects of habitat alteration and sensory disturbance are not significant based on potential moderate magnitude and regional geographic extent when using the TEM/PEM model and considering that the Project does not contribute to a cumulative effect. Although habitat alteration may result in a greater than negligible adverse effect within the RSA, it is unlikely that these effects would pose a risk to the long-term persistence and viability of marbled murrelets at the regional level.

Confidence and Risk

Moderate. There is high confidence in the TEM model results and moderate confidence in the PEM model and BC Model results. Confidence in the occurrence of marbled murrelet is low since formal surveys have not been completed. The primary uncertainty associated with the decision is related to knowledge regarding local populations. Little information is available on the presence or nesting behaviour of marbled murrelet within the RSA. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects.

The assumptions used in this assessment are precautionary, both in terms of the sizes of the disturbance ZOIs and magnitude of effect (i.e., complete loss of habitat), and likely overestimates potential Project effects on habitat availability. There is very low risk that the Project effects could exceed those used in this assessment. More likely, marbled murrelets, if present, would continue to some use portions of the sensory disturbance ZOIs and the effects will be less than those used in this assessment. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.8.4 Habitat Availability – Olive-sided Flycatcher

Habitat availability for olive-sided flycatcher includes changes to the amount or quality of effective nesting habitat (i.e., nesting habitat rated as moderate or high suitability) as a result of habitat alteration or sensory disturbance. Habitat alteration was assessed quantitatively within the RSA by calculating the area of effective nesting habitat that overlapped with the Project footprint. Sensory disturbance was assessed quantitatively within the RSA by calculating the area of effective nesting habitat that overlapped with the ZOI. The calculation of the ZOI followed the same methodology that was used for the Project effects assessment.

Residual Cumulative Effects Analysis

The cumulative habitat assessment indicated that 653 ha of effective nesting habitat may be lost or altered due to past, present, and future project activities within the RSA (Table 16.8-16). This represents a 2% loss of effective habitat for olive-sided flycatcher within the RSA. This represents less than 1% loss of effective habitat within the RSA due to Project-related activities.

Table 16.8-16: Summary of Change in Habitat Availability — Olive-sided Flycatcher

Habitat Type	Past, Present, Future (ha)				Project (ha)		Future (ha)		Total Habitat Change (ha)	RSA – Total Habitat (ha)	Cumulative RSA Habitat Change (%)
	Highway 37A	Past and Present Projects [1]	Past, Present, Future Activities	Area of Sensory Disturbance [2]	Red Mountain	Area of Sensory Disturbance	Bitter Creek Hydro Project	Area of Sensory Disturbance			
Nesting	<1	5	57	313	31	57	151	39	653	32,743	2

[1] Long Lake Hydroelectric Project, Stewart Bulk Terminals, Stewart World Port
[2] Area of sensory disturbance includes Hwy 37A and past/present projects

Characterization of Cumulative Residual Effect

Past, present, and future project activities are expected to have an adverse effect on olive-sided flycatcher effective nesting habitat due to habitat alteration and sensory disturbance. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The combined effects are considered to have a low magnitude within the RSA, because less than 5% of effective nesting habitat will be directly or indirectly affected. The geographic extent of the combined effects is expected to be regional. Habitat alteration and sensory disturbance are expected to be long-term in duration, will occur continuously, and are considered reversible. Context is considered low because olive-sided flycatchers are a species at risk in Canada where the cause of the population decrease is not well understood (EC 2016b). It is speculated that an available and constant supply of flying insects is likely a limiting factor for the species survival, and it is currently unknown whether the availability of nesting habitat is a limiting factor in Canada (EC 2016b). Therefore, olive-sided flycatcher may not be able to respond and adapt to adverse nesting habitat effects as readily as other migratory bird species.

Likelihood

Low, because there is an overlap of project activities and the effective nesting habitat for this species within the RSA, but the majority of this overlap is associated with past and future projects.

Significance

Not significant. The combined residual effects of habitat alteration and sensory disturbance are not significant based on a low magnitude, a long-term duration, and a regular occurrence. It is unlikely that these effects would pose a risk to the long-term persistence and viability of olive-sided flycatcher at the regional level.

Confidence and Risk

Moderate. The cause-effect relationships between the past, present, and future projects and olive-sided flycatcher are understood. Habitat modelling is a well-established tool to assess effects and a recognized standard was used to predict habitat suitable for the species. Modeled habitat ratings correlated well with the field observations. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.8.5 Mortality Risk – Common Nighthawk

Mortality risk for common nighthawk includes changes to wildlife mortality via direct pathways, such as incidental take during vegetation clearing and ground disturbance, collisions with Project-related traffic, or collisions and electrocution caused by the Powerline. Direct mortality risk due to collisions with vehicles or the Powerline was assessed qualitatively within the context of the RSA using information from baseline studies and habitat modelling in relation to roads and the Powerline. Information from the literature regarding traffic volumes or power line configurations considered to put birds at risk was also considered.

The Recovery Strategy for common nighthawk identified collisions with vehicles, aircraft, and human structures as a moderate severity threat with a medium casual certainty (EC 2016a). Severity reflects the population-level effect of a specific threat and causal certainty reflects the degree of known evidence to support the assessment of a specific threat (EC 2016a). Medium causal certainty indicates a correlation between the threat and population viability (EC 2016a).

Common nighthawks may roost or nest on gravel roads and trails, making them vulnerable to collisions with vehicles and possible nest or brood destruction, especially as the amount of traffic increases (Brigham et al. 2011; Campbell et al. 2006; EC 2016a). Roads that traverse nighthawk foraging habitats can also lead to increased collision risk between vehicles and nighthawks, which forage in open or semi-open areas with flying insects at dawn and dusk, often in large groups (Brigham et al. 2011; Campbell et al. 2006; EC 2016a). Open water provides primary foraging habitats, but artificial lighting that attracts flying insects can also attract large groups of foraging nighthawks (Campbell et al. 2006; EC 2016a). One study documented the causes of 477 incidents of nighthawk mortalities into 22 categories. The majority of mortalities were attributed to roadkill (i.e., 38.6%) and museum collecting (i.e., 32%); the remaining mortalities were spread out among the remaining categories (Campbell et al. 2006).

Collisions with vehicles are a significant source of mortality for common nighthawks in southern BC; this is likely due to high densities of nighthawks and roads in this region coupled with high traffic volumes (Campbell et al. 2006). Although nighthawks are distributed widely across BC, they become less common and more localized as latitude and elevation increases; occurrences are rare along the northern mainland coast, often occurring at the head of long inlets (Campbell et al. 2006).

Many bird species are also vulnerable to collisions with buildings, communication towers, wind turbines, transmission lines, and other vertical man-made structures, particularly during migration (Campbell et al. 2006). Common nighthawks are not especially vulnerable to collisions with buildings and communication towers (EC 2016a). The collision risk with wind turbines and other vertical man-made structures has not yet been quantified for common nighthawks (EC 2016a). Although collision risk with transmission lines has not been quantified for common nighthawk, it is presumed to be limited; however, adult males have been known to collide with transmission lines during courtship displays and such collisions may increase as development expands (EC 2016a). Nighthawks may also nest along transmission line corridors if the habitat includes open areas with short vegetation or rock outcroppings (Campbell et al. 2006; Hausleitner and Wallace 2012), which may increase the risk of collisions.

Residual Cumulative Effects Analysis

The highest nighthawk mortalities from vehicle collisions have been reported in the Okanagan valley and East Kootenay region (Campbell et al. 2006). Annual average daily traffic volume data from major highways in BC indicates that traffic volumes are considerably higher throughout the Okanagan valley and East Kootenay region (i.e., approximately 11,350 and 4,500 vehicles per day, respectively) compared to traffic volumes along Highway 37 and Highway 37A (i.e., 693 and 253 vehicles per day, respectively) (BC MOTI 2017). Furthermore, the expected annual traffic volume for the Project is 15,140 loads over eight years, which equates to an average of 5.18 loads per day. Since traffic on the Project Access Road will be considerably less than traffic in the Okanagan valley and East Kootenay region, and the density of nighthawks is expected to be much lower in the Project area compared to southern BC, the risk of mortality for common nighthawks due to collisions with Project-related traffic is anticipated to be low. A maximum speed limit of 50 km/hr will be enforced along the Access Road, which will further limit the risk of collision. If a nighthawk is hit by a vehicle along the Access Road, the incident should be reported to environmental staff immediately and the location should be noted and a description of habitat made in an effort to identify potential hotspots for nighthawk mortality.

Collisions with aircraft can also be a significant source of mortality for birds, particularly during migration (Campbell et al. 2006). It is expected that helicopters will be used in the RSA as a small part of the Project and other cumulative activities and the risk of mortality for common nighthawks due to collisions with helicopters is anticipated to be low.

Given that the density of nighthawks is expected to be low and effective nesting habitat is limited for nighthawks, the risk of mortality for common nighthawks due to collisions and electrocution caused by the Powerline is anticipated to be low.

Characterization of Cumulative Residual Effect

Past, present, and future projects are expected to have an adverse effect on common nighthawk mortality risk due to collisions with traffic along Highway 37A and collisions and electrocution caused by the Powerline. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The effects are considered to have a low magnitude within the context of the RSA, because the density of nighthawks is expected to be low. The geographic extent of the effects is expected to be regional. Mortality risk is expected to be long-term in duration and sporadic in frequency. Mortality risk is considered reversible following closure and reclamation of projects and associated roads.

Context is considered low because common nighthawks are a species at risk in Canada that are sensitive to changes in their environment (EC 2016a). It is speculated that an available and constant supply of flying insects is likely the most limiting factor for the species survival (Campbell et al. 2006). Common nighthawks also have a short breeding season that limits them to one brood per season, and clutch size is small (i.e., average two eggs; Campbell et al. 2006; EC 2016a). Therefore, common nighthawks may not be able to respond and adapt to adverse effects as readily as other migratory bird species.

Likelihood

Low because the density of nighthawks is expected to be low in the RSA. Only three nighthawks were observed during baseline studies for the Project, all along Highway 37A within approximately 4.5 km of the LSA. There is currently no confirmation of nesting habitat or activity within the Project LSA for common nighthawk.

Significance

Not significant. The residual effect of mortality risk is not significant for common nighthawk based on low magnitude and sporadic frequency. Although mortality risk may result in a greater than negligible adverse effect within the RSA, it is unlikely that these effects would pose a risk to the long-term persistence and viability of common nighthawks at the regional level.

Confidence and Risk

High. Habitat preferences of common nighthawk are well known and considerable data exists that quantifies the risk of mortality in various traffic volumes and other pathways. Furthermore, effective and tested mitigation measures will be in place to limit the effect. There is low risk that the effect will be higher than predicted. The precautionary approach was used in this assessment and the area of habitat that overlaps with the project footprint is low. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.8.6 Mortality Risk – Marbled Murrelet

Residual Cumulative Effects Analysis

Mortality risk for marbled murrelet includes potential direct mortality resulting from incidental take during vegetation clearing and ground disturbance during construction. Collisions with vehicles or Project infrastructure are considered highly unlikely since marbled murrelets fly at or above forest canopies, except when landing at their nests; this risk is not considered further here. Potential collisions with the Powerline are considered a medium level of concern according to the Recovery Strategy for the marbled murrelet in Canada (EC 2014a), but the causal certainty is considered low (i.e., the threat is assumed or plausible).

Little empirical data is available on the flight height of marbled murrelet, especially in differing weather and topographic conditions, both of which can constrain flight paths. Over two years on western Vancouver Island, mean flight height was found to range between 563 and 687 m and the lowest detection among 955 detections was 99 m; however the cloud ceiling was high or unlimited during each survey and topography was moderately restrictive (Redden et al. 2012).

These data suggest the risk of marbled murrelet collision with the Powerline is low. Powerline height is anticipated to range between 5 and 10 m above the ground surface, but longer spans with wires at greater heights are possible. As a result, the risk of collision cannot be entirely dismissed.

Characterization of Cumulative Residual Effect

The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The magnitude of effects on direct mortality are considered low to moderate and depend, in part, on better understanding of local and regional populations. Collisions with the Powerline are considered unlikely; however, if populations are low, mortality of one or more individuals could have a moderate effect on the population. Residual effects of mortality are considered regional because any mortality could occur within the RSA. The duration is considered long-term because mortalities would occur at any time. Frequency of this effect is sporadic as mortalities are expected to be rare, with the highest risk occurring during the nesting period. The effect of mortality risk is considered reversible following the closure and reclamation of projects, activities, and their associated roads and infrastructure.

Context is considered moderate because marbled murrelet are a species at risk in Canada and may not be able to respond and adapt to adverse nesting habitat effects as readily as other migratory bird species.

Likelihood

Moderate. It is expected that the mitigation measures outlined in Section 16.6 will be effective in reducing direct mortality risk for marbled murrelet, but there is still a low probability that some mortalities may occur during the life of the Project.

Significance

Not significant. There may be residual effects of direct mortality on marbled murrelet; however, these effects are not significant because they are low to moderate in magnitude, local in extent, and reversible.

Confidence and Risk

Moderate. The primary uncertainty associated with the decision is related to the risk of collision with the Powerline. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. Little information is available on the risk of marbled murrelet collisions with power lines or on the status of local populations. The assumptions used in this assessment are precautionary in terms of the potential for collisions. Present information indicates that marbled murrelets generally flight well above the height of power lines during daily migrations, and the assessment likely overestimates the potential for collisions. There is very low risk that the Project effects could exceed those used in this assessment. More likely, marbled murrelets, if present, will fly well above any power lines and the effects will be less than those used in this assessment. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.9 Residual Cumulative Effects Assessment — Raptors

One residual effect, habitat availability, is predicted to have a potential cumulative effect on raptors. This residual effect has the potential to interact with habitat availability caused by habitat alteration from past projects and activities, as well as due to habitat alteration and sensory disturbances from present and future activities.

16.8.4.9.1 Habitat Availability – Northern Goshawk

Habitat availability for the northern goshawk *laingi* subspecies includes changes to the amount or quality of effective nesting or foraging habitat (i.e., habitat rated as high or moderate suitability) as a result of habitat alteration or sensory disturbance. Habitat alteration was assessed quantitatively within the RSA by calculating the area of effective nesting or foraging habitat that overlapped with past, present, and future projects and activities.

Sensory disturbance was assessed quantitatively within the RSA by calculating the area of effective nesting or foraging habitat that overlapped with a 500 m ZOI around past, present, and future projects. For nesting habitat, all high and moderate WHRs within the ZOI were downgraded to a minimum of low; low habitat ratings remained low and nil habitat ratings remained nil. For foraging habitat, all WHRs within the ZOI were downgraded by one class to a minimum of low (i.e., high becomes moderate; moderate becomes low; low stays low; and nil remains nil). The resulting habitat values were then summarized and compared to the available effective nesting habitat within the RSA.

Residual Cumulative Effects Analysis

The cumulative habitat assessment indicated that 999 ha of effective nesting habitat may be adversely affected due to habitat alteration and sensory disturbance (Table 16.8-17). This represents 15% of effective nesting habitat within the RSA, and the Project contributes 2% of this change in habitat availability. The cumulative habitat assessment indicated that 1,295 ha of effective foraging habitat may be adversely affected due to habitat alteration and sensory disturbance (Table 16.8-17). This represents 8% of effective foraging habitat within the RSA and the Project contributes 2% of this change in habitat availability.

Table 16.8-17: Summary of Change in Habitat Availability — Northern Goshawk

Habitat Type	Past, Present, Future (ha)				Project (ha)		Future (ha)		Total Habitat Change (ha)	RSA – Total Habitat (ha)	Cumulative RSA Habitat Change (%)
	Highway 37A	Past and Present Projects [1]	Past, Present, Future Activities	Area of Sensory Disturbance [2]	Red Mountain	Area of Sensory Disturbance	Bitter Creek Hydro Project	Area of Sensory Disturbance			
Nesting	9	18	33	661	10	143	68	56	999	6,692	15
Foraging	27	33	88	621	33	263	175	55	1,295	16,743	8

[1] Long Lake Hydroelectric Project, Stewart Bulk Terminals, Stewart World Port
[2] Area of sensory disturbance includes Hwy 37A and past/present projects

Characterization of Cumulative Residual Effect

Past, present, and future projects are expected to have an adverse effect on effective nesting and foraging habitat for the northern goshawk *laingi* subspecies due to habitat alteration and sensory disturbance. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The combined effects are considered to have a moderate magnitude within the RSA because 15% of effective nesting and 8% of foraging habitat will be directly or indirectly affected by the combined Project footprint and 500 m ZOI. The geographic extent of the combined effects is expected to be regional. Habitat alteration and sensory disturbance are expected to be long-term in duration. Effects to habitat availability will occur continuously but are considered reversible once successful reclamation has occurred and project activities cease.

Context is considered low because the northern goshawk *laingi* subspecies is a species at risk in BC and Canada that is sensitive to large-scale habitat changes (COSEWIC 2013b) and disturbances around its nest sites (BC MOE 2013a). The main threat to the *laingi* subspecies is forest harvesting that reduces and fragments nesting and foraging habitat, adversely affecting the availability of suitable nest sites, and the abundance and diversity of prey (NGRT 2008; FLNRO 2013; COSEWIC 2013b). In addition, goshawks typically rear only one brood per season, and clutch size is relatively small (i.e., average two to four eggs) with only two to three fledglings per successful nest (Squires and Reynolds 1997). Therefore, the *laingi* subspecies may not be able to respond and adapt to adverse habitat effects as readily as other raptors.

Likelihood

High because past, present, and future project footprints overlap with effective nesting and foraging habitat for this subspecies and the Project contributes a 2% change in habitat availability.

Significance

Not significant. The combined cumulative residual effects of habitat alteration and sensory disturbance are assessed to be not significant for the northern goshawk *laingi* subspecies. The majority of the cumulative residual effect is associated with the ZOI of past projects. Although habitat alteration and sensory disturbance may result in a greater than negligible adverse effect within the LSA, it is unlikely that these effects would pose a risk to the long-term persistence and viability of the *laingi* subspecies at the regional level.

Confidence and Risk

Moderate. Habitat preferences of northern goshawk are well known and several habitat models based on current knowledge were used to determine the assessment. There is a reasonable but not full understanding of the cause-effect relationship between habitat alteration and the persistence of the species at the population level. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. The assumptions used in this assessment are precautionary, both in terms of the sizes of the disturbance ZOIs and magnitude of effect (i.e., complete loss of habitat), and likely overestimate potential effects on habitat availability. There is very low risk that the effects could exceed those used in this assessment. More likely, northern goshawk *laingi* will continue to some use portions of the sensory disturbance ZOIs and the effects will be less than those used in this assessment. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.9.2 Habitat Availability – Western Screech-owl

Habitat availability includes habitat alteration and sensory disturbance. Habitat alteration was assessed quantitatively for western screech-owl by calculating the area of effective nesting habitat (i.e., habitat rated as high or moderate suitability) that overlapped with the past, present, and future projects and activity footprints. The change to habitat availability due to sensory disturbance was quantified by downgrading the high quality habitat that occurred within the ZOI to moderate quality habitat, and moderate quality habitat to low quality habitat. See Table 16.3-5 for rationale of the ZOI.

Residual Cumulative Effects Analysis

Approximately 57 ha of effective nesting habitat (representing 1% of the effective habitat in the RSA) will be altered by past, present, and future project footprints (Table 16.8-18). The majority of the effective nesting habitat has been lost due to past projects and activities.

Table 16.8-18: Summary of Change in Habitat Availability — Western Screech-owl

Habitat Type	Past, Present, Future (ha)				Project (ha)		Future (ha)		Total Habitat Change (ha)	RSA – Total Habitat (ha)	Cumulative RSA Habitat Change (%)
	Highway 37A	Past and Present Projects[1]	Past, Present, Future Activities	Area of Sensory Disturbance[2]	Red Mountain	Area of Sensory Disturbance	Bitter Creek Hydro Project	Area of Sensory Disturbance			
Nesting	<1	1	12	0	3	0	40	0	57	4,127	1

[1] Long Lake Hydroelectric Project, Stewart Bulk Terminals, Stewart World Port
[2] Area of sensory disturbance includes Hwy 37A and past/present projects

Characterization of Cumulative Residual Effect

Past, present, and future projects are expected to have an adverse effect on western screech-owl nesting habitat due to reduced habitat availability. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The cumulative effect is low in magnitude because 1% of effective nesting habitat within the RSA will be directly or indirectly affected by the combined cumulative project footprints and ZOIs. The geographic extent of the effect is regional with the majority of disturbance occurring in the Bear River valley. Habitat alteration and sensory disturbance are expected to be long-term in duration. Effects on habitat availability will occur continuously but are considered reversible following reclamation.

The context is considered low because the western screech-owl is a species at risk in BC (Blue-listed) and Canada (Threatened), and habitat loss is identified as a potential threat (COSEWIC 2012b, BC MOE 2013b).

Likelihood

High. Past, present, and future projects overlap with potential nesting habitat for this species. The likelihood that sensory disturbance effects to owls within a 300 m ZOI is low because, to date, no owls have been detected within the RSA, and the habitat occurs in small patches that are unlikely to support breeding pairs.

Significance

Not significant. The effect of habitat alteration is not significant based on moderate magnitude and localized geographic extent (i.e., the Bear River valley). It is unlikely that these cumulative effects would pose a risk to the long-term persistence and viability of western screech-owl if they were to occur in the RSA. There have been no western screech-owl detections in the RSA.

Confidence and Risk

Moderate. The cause-effect relationships between potential habitat effects and owls are not fully understood, and population-level effects at broader geographic scale (e.g., broad-scale loss of large trees/snags with cavities), combined with other threats, such as the spreading occurrence of barred owls and resulting predation, may mask any effect that this project could have on individual western screech-owl. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.10 Residual Cumulative Effects Assessment — Non-migratory Game Birds

Two residual effects, habitat availability and mortality risk, are predicted to have a potential cumulative effect on non-migratory game birds. The residual effect of habitat availability could interact with habitat availability caused by habitat alteration from past projects and activities, as well as due to habitat alteration and sensory disturbances from present and future project and activities, which could result in a nibbling loss of habitat.

The residual effect of mortality risk could interact with mortality risk caused by vehicle collision, incidental take during vegetation clearing and ground disturbances, and collision and electrocution due to powerlines from past, present, and future projects and activities, which could result in an additive cumulative effect.

16.8.4.10.1 Habitat Availability — Sooty Grouse

Habitat availability includes changes to the amount of effective habitat as a result of habitat alteration or sensory disturbance. Habitat alteration was assessed quantitatively for sooty grouse within the context of the RSA. Altered habitat was calculated as the effective habitat (high and moderate quality) that overlapped with past, present, and future project footprints. The ZOI for sooty grouse was defined as any area within 300 m of project footprints (see Table 16.3-5 for rationale of ZOIs). Sensory disturbance was assessed by downgrading high and moderate quality habitat located within the ZOI by one habitat class (i.e., high becomes moderate and moderate becomes low).

Residual Cumulative Effects Analysis

The cumulative habitat assessment indicated that 1,396 ha of effective summer living and nesting habitat may be adversely affected in the RSA due to habitat alteration and sensory disturbance (Table 16.8-19). This represents a 3% loss of effective nesting habitat within the RSA, where the Project contributes less than 1% of this change in habitat availability. The cumulative habitat assessment indicated that 564 ha of effective winter living habitat may be adversely affected in the RSA due to habitat alteration and sensory disturbance (Table 16.8-19). This represents 3% loss of effective foraging habitat within the RSA, and the Project contributes less than 1% of this change in habitat availability.

Table 16.8-19: Summary of Change in Habitat Availability — Sooty Grouse

Habitat Type	Past, Present, Future (ha)				Project (ha)		Future (ha)		Total Habitat Change (ha)	RSA – Total Habitat (ha)	Cumulative RSA Habitat Change (%)
	Highway 37A	Past and Present Projects [1]	Past, Present, Future Activities	Area of Sensory Disturbance [2]	Red Mountain	Area of Sensory Disturbance	Bitter Creek Hydro Project	Area of Sensory Disturbance			
Summer Living	<1	19	94	862	76	139	98	110	1,396	47,151	3
Winter Living	<1	3	48	285	26	78	82	43	564	19,433	3

[1] Long Lake Hydroelectric Project, Stewart Bulk Terminals, Stewart World Port
[2] Area of sensory disturbance includes Hwy 37A and past/present projects

Characterization of Cumulative Residual Effect

Past, present, and future Projects will have an adverse effect on sooty grouse summer and winter living habitat availability. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. Cumulative effects on habitat availability have a low magnitude rating, because effects will affect less than 5% of the effective habitat within the RSA for both summer and winter seasons. The geographical extent of habitat effects is regional. The duration of cumulative effects on habitat availability will be long-term and occur on a continuous basis. Effects on habitat availability are considered reversible, as most affected habitat will recover once sensory disturbance ceases and remaining altered habitat will eventually recover following site reclamation.

Sooty grouse populations can increase dramatically following fire and timber harvest (Zwickel and Bendell 2005); therefore, for this reason grouse are considered resilient to changes in habitat availability and context was rated high for this VC.

Likelihood

High, because the past, present, and future project footprints overlap with effective summer and winter habitat.

Significance

Not significant. Cumulative effects on habitat availability are considered not significant because any residual effect will have a low magnitude and be reversible. The majority of lost effective habitat is associated to sensory disturbance. Sooty grouse populations are also considered to have high resilience to changes in habitat availability. Based on these criteria it is unlikely that a measurable effect on the size or viability of the sooty grouse population within the RSA will occur.

Confidence and Risk

High. There is a good understanding of the cause-effect relationship between the Project and Sooty Grouse habitat availability. The primary uncertainty is in how far habitat effects from sensory will extend beyond the Project footprint. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. The 300 m ZOI around the project infrastructure, plus any predicted effects of project noise beyond 300 m, likely overestimates potential Project effects on habitat availability. There is very low risk that the Project effects could exceed those used in this assessment. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.10.2 Habitat Availability — White-tailed Ptarmigan

Habitat availability includes changes to the amount or quality of available habitat as a result of habitat alteration or sensory disturbance. Habitat alteration was assessed quantitatively for white-tailed ptarmigan and altered habitat was calculated as the effective living habitat (high and moderate quality) that overlapped with past, present, and future project footprints. The ZOI for white-tailed ptarmigan was defined as any area within 300 m of a project footprint. Sensory disturbance was assessed by downgrading high and moderate quality habitat located within the ZOI by one habitat class (i.e., high becomes moderate and moderate becomes low.

Residual Cumulative Effects Analysis

Past, present, and future projects will have direct effects on 309 ha of effective winter living habitat, which represents less than 1% of the total effective winter living habitat within the RSA (Table 16.8-20). Approximately 231 ha of effective winter living habitat would be subject to sensory disturbance from the present Project.

Table 16.8-20: Summary of Change in Habitat Availability — White-tailed Ptarmigan

Habitat Type	Past, Present, Future (ha)				Project (ha)		Future (ha)		Total Habitat Change (ha)	RSA – Total Habitat (ha)	Cumulative RSA Habitat Change (%)
	Highway 37A	Past and Present Projects [1]	Past, Present, Future Activities	Area of Sensory Disturbance [2]	Red Mountain	Area of Sensory Disturbance	Bitter Creek Hydro Project	Area of Sensory Disturbance			
Winter Living	0	12	10	18	11	231	0	28	309	46,268	<1

[1] Long Lake Hydroelectric Project, Stewart Bulk Terminals, Stewart World Port
[2] Area of sensory disturbance includes Hwy 37A and past/present projects

Characterization of Cumulative Residual Effect

Past, present, and future projects will have an adverse effect on habitat availability for white-tailed ptarmigan. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. Project effects on habitat availability have a low magnitude rating because less than 1% of the effective habitat within the RSA will be affected by habitat alteration or sensory disturbance. The geographical extent of habitat effects is regional. The duration of project effects on habitat availability will be long-term. Effects to altered habitat will be considered permanent as it can take many years for alpine vegetation to recover following disturbance. The area affected by sensory disturbance should return to the original habitat effectiveness following closure and reclamation of projects and activities. Effects on habitat availability are considered reversible, as most affected habitat will recover once sensory disturbance ceases and remaining altered habitat will eventually recover following site reclamation. Cumulative effects on habitat availability will occur continuously.

White-tailed ptarmigan populations are well adapted to stochastic environments and populations are known to persist even with regular low densities, poor survival, and low fecundity (Martin et al. 2015). Populations or ptarmigan are also known to avoid local extinction through immigration following episodes of low reproduction or survival (Martin et al. 2015). For these reasons, ptarmigan are considered resilient to changes in habitat availability and context was rated high for this VC.

Likelihood

High. The Project footprint will overlap with high and moderate quality habitat.

Significance

Not Significant. Project effects on habitat availability for white-tailed ptarmigan are considered not significant because any residual effect will have a low magnitude and be reversible over time. White-tailed ptarmigan populations are also considered to have high resilience to changes in habitat availability. Based on these criteria it is unlikely that the Project will have a measurable cumulative effect on the size or viability of the white-tailed ptarmigan population within the RSA.

Confidence and Risk

High. There is a good understanding of the cause-effect relationship between the Project and white-tailed ptarmigan habitat availability. The primary uncertainty is in how far habitat effects from sensory will extend beyond the Project footprint. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. The 300 m ZOI around the project infrastructure, plus any predicted effects of project noise beyond 300 m, likely overestimates potential Project effects on habitat availability. There is very low risk that the Project effects could exceed those used in this assessment. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.10.3 Mortality Risk— Sooty Grouse

Mortality risk includes changes to non-migratory game bird mortality via direct and indirect pathways. Direct mortality pathways for non-migratory game birds include incidental take during vegetation clearing and ground disturbance activities, collisions with traffic along roads, or collisions and electrocution caused by the Powerline.

Direct mortality risk due to incidental take was assessed qualitatively within the context of the RSA by identifying important habitat areas and features from baseline studies and habitat modelling and assessing them in the context of past, present, and future project footprints.

Collisions with high tension power lines can be an important source of mortality for grouse (Catt et al. 1994; Bevanger 1995). Research from Norway estimates that black grouse, a species with similar habitat requirements and size as sooty grouse, collide with powerlines at a rate of 0.495 mortalities/km/year, after accounting for search bias, with all recorded collisions occurring during the non-breeding season (Sept to May; Bevanger 1995). This estimate was used to calculate the expected number of collision related deaths annually based on the length of transmission line (kms) that will run through winter sooty grouse habitat.

Based on records of licensed harvest in the RSA (MU 6-14 and MU 6-16) (data provided by FLNRO; K. Dixon pers. comm. 2017) between 1976 and 2015, a total of 559 sooty grouse (blue grouse) have been harvested with an average of 14 sooty-grouse/year (range 0 to 153 sooty grouse/year). And between 1976 and 2015, a total of 6,366 ruffed grouse have been harvested within the same area with an average of 159 Ruffed Grouse/year.

Residual Cumulative Effects Analysis

There are 70 km of powerline in the RSA that overlap with winter habitat of sooty grouse. Using an estimated collision rate of 0.495 collisions/km/year (Bevanger 1995); there could be approximately 35 mortalities of sooty grouse associated with transmission lines per year within the RSA. The daily aggregate bag limit for Sooty Grouse is 10 and the aggregate possession limit is 30 within the Skeena hunting region (FLNRO 2016b); so expected annual powerline mortalities associated with transmission lines would be approximately the equivalent of four additional hunters meeting the daily bag limit or being five sooty grouse over the aggregate possession limit. The present Project contributes to approximately seven Sooty Grouse mortality associated with transmissions line per year, which is less than the bag limit for one hunter. Ruffed grouse are also found in the same management unit, and the population can withstand the removal of approximately 159 individuals per year to hunting pressures, which signifies that grouse populations have the potential to be resilient to hunting pressure (mortality).

Characterization of Cumulative Residual Effect

Past, present, and future projects will have an adverse cumulative effect on sooty grouse mortality risk. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The magnitude of the cumulative effects on direct mortality was considered low because estimates of transmission line collisions were close to the acceptable aggregate possession limits, and the present Project could potentially contribute to 20% of this loss. Residual effects of mortality are considered regional. The duration is long-term because mortalities could occur any time. Frequency of this effect is sporadic, as mortalities are expected to be rare, with the highest risk during most spring and fall migration (Zwickel and Bendell 2005). Effects of mortality were considered reversible at the population level, because high reproductive rates and immigration can compensate for mortalities (Zwickel and Bendell 2005).

Sooty grouse population densities can increase dramatically following logging or natural disturbances (Zwickel and Bendell 2005) and rapidly repopulate breeding areas following experimental removal (Zwickel 1972; Bendell et al. 1972); therefore this species is expected to be resilient to any mortality effects and context was rated as high.

Likelihood

Moderate. There is a small probability that some mortalities will occur within the RSA due to past, present, and future projects.

Significance

Not significant. There is likely to be direct mortality on sooty grouse; however, these effects are assessed as not significant because sooty grouse resiliency was rated as high.

Confidence and Risk

Moderate. There is specific information available on the mortality associated with collisions for sooty grouse that supports the assessment and the cause-effect relationship between the Project and sooty grouse. Confidence is moderated due to the moderate effectiveness of mitigation measures for direct mortalities and the applicability of the supporting data. The models used to estimate powerline related mortalities are based on a similar species in similar habitat, but this may not accurately reflect mortality risk for sooty grouse in the RSA. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.10.4 Mortality Risk — White-tailed Ptarmigan

Mortality risk includes changes to non-migratory game bird mortality via direct and indirect pathways. Direct mortality pathways for white-tailed ptarmigan may include incidental take during vegetation clearing and ground disturbance activities and collisions and electrocution caused by the Powerline.

Direct mortality risk due to collisions with transmission lines was assessed quantitatively. Collisions with high tension power lines can be a significant source of mortality for grouse (Catt et al. 1994; Bevanger 1995). Research from Norway estimates that willow ptarmigan, a species with similar habitat requirements and size as white-tailed ptarmigan, collide with powerlines at a rate of 3.384 mortalities/km/year, after accounting for search bias (Bevanger 1995). This estimate was used to calculate the expected number of collision related deaths annually, based on the length of transmission line (in kilometres) that will run through white-tailed ptarmigan habitat.

Residual Cumulative Effects Analysis

There are 4 km of transmission lines in the RSA located within alpine habitat, which white-tailed ptarmigan could travel through year-round. Using a collision rate of 3.4 collisions/km/year (Bevanger 1995), it is estimated there could be 14 mortalities of white-tailed ptarmigan associated with power lines per year within the RSA. The daily aggregate bag limit for ptarmigan is 10 and the aggregate possession limit of 30 within the Skeena hunting region (FLNRO 2016b); so expected annual powerline mortality would be less than a hunter meeting the aggregate possession limit.

Characterization of Cumulative Residual Effect

Past, present, and future projects are expected to have an adverse cumulative effect on white-tailed ptarmigan mortality risk. The criteria and rationale for potential residual effects are outlined in Section 16.7.2.5. The magnitude of effects on direct mortality was considered low because estimates of transmission line collisions were less than 30 mortalities per year. Cumulative effects of mortality are considered mostly local, because the majority of the transmission line and associated mortality would occur within the Project LSA and could influence population density within the LSA. The duration is long-term and sporadic. Effects of mortality were considered reversible at the population level, because high reproductive rates and immigration can compensate for mortalities (Martin et al. 2015).

White-tailed ptarmigan are rated as having high context. This species has a high reproductive rate, with juveniles reaching reproductive maturity by 9 to 10 months' generation times between 1.9 and 2.62 years (Martin et al. 2015). Ptarmigans can also recover from periods of low survival through immigration from nearby populations (Martin et al. 2015).

Likelihood

Moderate. There is a small probability that a few mortalities will still occur within the RSA due to past, present, and future project activities or transmission lines associated with these projects.

Significance

Not significant. There are likely to be cumulative effects of direct mortality on white-tailed ptarmigan; however, these effects are assessed as not significant because they are low in magnitude, mostly local in extent, reversible, and Sooty Grouse resiliency was rated as high.

Confidence and Risk

High. There is a good understanding of the cause-effect relationship between the Project and white-tailed ptarmigan availability. The primary uncertainty is in how far habitat effects from sensory will extend beyond projects and activities. Uncertainty has the potential to affect the likelihood or the significance of predicted residual cumulative effects. The 300 m ZOI likely overestimates potential effects on habitat availability. There is very low risk that the effects could exceed those used in this assessment. Section 16.9 identifies the proposed strategy to evaluate the accuracy of effects predictions, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project.

16.8.4.11 Summary of Cumulative Effects Assessment

The residual cumulative effects assessment significance characterizations for each Wildlife VC are summarized in Table 16.8-21. There are no predicted significant cumulative effects.

Table 16.8-21: Summary of Residual Cumulative Effects Assessment on Wildlife

Valued Component	Residual Cumulative Effect	Context	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood	Significance	Confidence
Mountain goat	Habitat availability	L-N	L	R	LT	C	R	High	Not Significant	Moderate
	Mortality risk	N	N-L	L	LT	R-C	PR	Low	Not Significant	Moderate
Grizzly bear	Habitat availability	H	L-Moderate	R	LT	C	R	High	Not Significant	Moderate
	Mortality risk	N	L	R	LT	S	R	Low	Not Significant	High
Moose	Habitat availability	H	L	R	LT	C	R	High	Not Significant	Moderate
	Mortality risk	N	L	R	LT	S	R	Low	Not Significant	Moderate
Marten	Habitat availability	H	L	L	LT	C	R	High	Not Significant	High
	Habitat distribution/ movement	H	L	L	LT	S	R	Low	Not Significant	High
	Mortality risk	N	L	L	LT	S	R	Low	Not Significant	High
Wolverine	Habitat availability	H	L-Moderate	R	LT	C	R	Moderate	Not Significant	Moderate

Valued Component	Residual Cumulative Effect	Context	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood	Significance	Confidence
Hoary marmot	Habitat availability	N	L	L	LT	C	R	High	Not Significant	Moderate
	Mortality risk	N	Moderate	L	LT	S	R	Moderate	Not Significant	Moderate
Bats	Habitat availability	H	Moderate	L	LT	C	R	High	Not Significant	Moderate
Bird guilds	Habitat availability	H	L	R	LT	C	R	High	Not Significant	Moderate
MacGillivray's warbler	Habitat availability	H	L	R	LT	C	R	High	Not Significant	High
Black swift	Habitat availability	L	L	L-R	LT	C	R	Moderate	Not Significant	Moderate
Common nighthawk	Habitat availability	L	L	R	LT	C	R	Low	Not Significant	Moderate
	Mortality risk	L	L	R	LT	S	R	Low	Not Significant	High
Marbled murrelet	Habitat availability	Moderate	Moderate	R	LT	C	R	Low	Not Significant	Moderate
	Mortality risk	Moderate	L-Moderate	R	LT	S	R	Low to Moderate	Not Significant	Moderate
Olive-sided flycatcher	Habitat availability	L	L	R	LT	C	R	Low	Not Significant	Moderate
Northern goshawk	Habitat availability	L	Moderate	R	LT	C	R	High	Not Significant	Moderate

Valued Component	Residual Cumulative Effect	Context	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Likelihood	Significance	Confidence
Western screech-owl	Habitat availability	L	L	R	LT	C	R	High	Not Significant	Moderate
Sooty grouse	Habitat availability	H	L	R	LT	C	R	High	Not Significant	High
	Mortality risk	H	L	R	LT	S	R	Moderate	Not Significant	Moderate
White-tailed ptarmigan	Habitat availability	H	L	R	LT	C	R	High	Not Significant	High
	Mortality risk	H	L	L	LT	S	R	Moderate	Not Significant	High

Context: N-negligible; L-low; Moderate-moderate; H-high
Magnitude: N-negligible; L-low; Moderate-moderate; H-high
Geographic Extent: D-discrete; L-local; R-regional; BR-beyond regional
Duration: ST-short-term; LT-long-term; P-permanent
Frequency (of occurrence): O-one time; S-sporadic; R-regular; C-continuous
Reversibility: I-irreversible; PR-partially reversible; R-reversible

16.9 Follow-up Effects Monitoring Program

IDM has identified a follow-up strategy to evaluate the accuracy of effects predictions and effectiveness of proposed mitigation measures in regards to Wildlife VCs. The strategy focuses on implementation of the WMP (Volume 5, Chapter 29). The purpose of the WMP is to minimize the effects of the Project's activities on Wildlife and Wildlife Habitat, monitor the results of mitigation to ensure effectiveness, and adaptively manage for any unanticipated effects resulting from the Project. The WMP is intended to ensure that wildlife continue to use habitat in areas adjacent to the Project footprint and within the broader Project area while reducing the potential for Project-related injury or mortality to wildlife. The WMP provides guidance to protect and limit disturbances to Wildlife and Wildlife Habitat from Project activities.

The program involves the implementation of widely recognized BMPs and development of procedural mitigation measures during Project planning to minimize anticipated effects. The monitoring program is intended to detect unanticipated effects where adaptive management protocols will be triggered. Many mitigation measures have already been implemented during the planning stages of the Project. These include Project design such as site and route selection, selection of best available technologies to-date for Project infrastructure and mining equipment, and a commitment to progressive reclamation.

In the event that original predictions of effects and mitigation effectiveness are not as expected, adaptive management principles and strategies will be implemented. Adaptive management will require consideration of monitoring results, management reviews, incident investigations, shared traditional, cultural, or local knowledge, new or improved scientific methods, regulatory changes, or other Project-related changes. Mitigation and monitoring strategies for wildlife will be updated to maintain consistency with action plans, management plans, and BMPs that may become available during the life of the Project. Key stakeholders, Aboriginal Groups, and government agencies will be involved, as necessary, in developing effective strategies and additional mitigation.

A key component of the follow-up strategy is evaluating Application/EIS predictions. This will be accomplished through various monitoring programs designed to detect unanticipated Project-related effects. Monitoring details are summarized by potential effect in Table 16.9-1 and described in more detail within the WMP (Volume 5, Chapter 29).

The follow-up strategy will also incorporate means to evaluate the effectiveness of implemented mitigation. Adaptive management principles rely on this evaluation to assess whether further mitigation is required to achieve desired outcomes. Table 16.9-2 provides examples of how mitigation measures can be evaluated.

Table 16.9-1: Evaluating Accuracy of Effects Predictions on Wildlife

Potential Effect or Pathway	Evaluation of Accuracy of Predictions
Habitat availability and distribution	• Comparison of as-builts to proposed footprint to evaluate magnitude and extent • Use reclamation end-use goals and outcomes to assess reversibility • A noise monitoring program will be undertaken to assess the magnitude of noise effects from Project activities in comparison to noise modelling. • Wildlife monitoring for focal species (i.e., mountain goat, raptor nests in the RSA) and tracking of incidental observations or human-wildlife interactions
Mortality	• Conducted through general wildlife monitoring programs, such as tracking of vehicle/wildlife collisions • Enforcement of no-hunting policy • Continuation of mortality, harvest and population surveys at a regional or provincial level (not an IDM responsibility)
Chemical hazards	• Routine monitoring of TMF use by migratory birds.

Table 16.9-2: Evaluating Effectiveness of Mitigation Approaches

Mitigation Approach	Evaluation of Effectiveness
Project design	• Comparison of as-builts to proposed footprint • Development of the closure and reclamation plan • Annual reporting on progressive reclamation activities
Wildlife education program	• Annual reporting of wildlife training provided to staff, contractors and visitors • Annual reporting of human-wildlife interactions
Wildlife protection protocols	• Annual reporting of wildlife training provided to staff, contractors and visitors • Annual reporting of human-wildlife interactions • The Project site will be audited on a regular basis to evaluate efforts to limit attractants to wildlife (e.g. bears) and bear-proof buildings and Project infrastructure.
Minimize habitat disturbance	• Comparison of as-builts to proposed footprint • Documenting results of preclearing surveys and identification of sensitive habitats with implemented buffers • Routine noise monitoring to evaluate sensory effects
Reduce barriers or filters to movement	• Barriers to movement primarily relate to road; therefore, monitoring of – Amphibian usage of culverts and drift fences (as applicable) – Wildlife encounters and – Vehicle collisions

Mitigation Approach	Evaluation of Effectiveness
Manage vehicle traffic	• Monitor wildlife encounters and vehicle collisions
Prevent wildlife entrapment	• Monitor areas of potential entrapment: − Ventilation shafts and portal entrances (e.g., bats) − TMF − Open bodies of water such as collection ponds
Manage chemical hazards	• Document and enforce appropriate storage of hazardous materials including fuel, explosives, and other materials. • Develop water quality monitoring program to address waste rock and TMF seepages
Manage attractants	• Document and enforce appropriate waste management protocols • Document human-wildlife interactions • Routinely monitor wildlife deterrents (e.g., fencing or noise makers) to ensure they are functioning as intended • Monitor reclamation activities to ensure vegetation is adequately established.

IDM will report on Project mitigation and monitoring activities related to Wildlife and Wildlife Habitats as part of annual reporting. The reporting will generally include the following information:

- Summarize wildlife mitigation measures implemented;
- Describe any investigations of Project-related wildlife mortality, the results of the investigations, and any corrective actions taken.
- Summarize any consultation with regulators, Project-related working groups, Aboriginal Groups, or stakeholders regarding on-site wildlife issues.

Every three years, or as appropriate based on data collection, IDM will review the results of the annual monitoring and develop a detailed report on trends in monitoring indicators. The report will include a retrospective analysis of wildlife distribution and abundance relative to baseline conditions and natural variability, as well as identified Project thresholds. Statistical analyses of the monitoring results will be performed where appropriate.

16.10 Conclusion

No significant change in Wildlife and Wildlife Habitat are predicted to occur at a regional scale due to the Project. Likewise, non-significant cumulative effects are not anticipated. All residual effects were considered non-significant due to the discrete or local geographical extent, and low to moderate magnitude of the anticipated effects. The assessment of significance is contingent on the complete implementation of mitigation measures. The maintenance of ecological conditions that support Wildlife and Wildlife Habitat may be altered in Bitter Creek, but not to the extent that productivity will be outside of the range of the existing baseline.

The results of this assessment have been carried forward to inform the Health Effects Assessment (Volume 3, Chapter 22) and used in the development of the Screening Level Ecological Risk Assessment (Volume 8, Appendix 22-B). The results of this assessment have also informed the assessment of potential Project effects on Nisga'a Nation Treaty interests (Chapter 27), and on Tsetsaut Skii km Lax Ha's and Métis Nation BC's Aboriginal Interests and Current Use of Lands and Resources for Traditional Purposes (Chapters 20.10, 25, and 26).

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