13. ASSESSMENT OF WILDLIFE EFFECTS

13.1 INTRODUCTION

The effects assessment for wildlife describes the existing wildlife and wildlife habitat in the regional study area (RSA; Section 13.3), historical activities within the RSA (Section 13.4), objectives of relevant land use plans (Section 13.2), and the spatial and temporal boundaries of the assessment (Section 13.6.2). Baseline study reports are located in Appendix 13-A. The list of valued components (VCs) and the potential effects on these VCs raised by First Nations, government regulators, regional planning strategies, and scientific research are listed in Sections 13.6 and to 13.7. Each wildlife VC is addressed in a separate section of these chapters and is subdivided by the potential effects deemed to be of concern for that VC. Where issues are directly and indirectly linked, sections are cross-referenced to avoid redundancy.

The assessment then evaluates the significance of the residual effects on each wildlife VC (Section 13.9) and provides a summary of the effects of the Project on wildlife (Section 13.10). For those VC with residual effects, the potential cumulative effects of the Murray River Project (the Project) with other residual effects of human activities in this region are evaluated (Section 13.11). A summary of the effects assessment results and conclusions are presented at the end of this chapter in Section 13.12.

13.2 REGULATORY AND POLICY FRAMEWORK

13.2.1 Wildlife Legislation

The BC Ministry of Forests, Lands and Natural Resource Operation (BC MFLNRO) Region 7B (Peace Zone) manages wildlife in the area. The Pacific/Yukon Region of Environment Canada is the federal agency responsible for wildlife and species at risk in the area. Legislation, regulations, policies, standards, and guidelines pertaining to the protection of wildlife and wildlife habitat are enforced under both federal and provincial legislation, as listed in Table 13.2-1. Standards and best practices are guiding statements that allow development to occur in a way that will avoid, limit, or mitigate effects on aquatic and riparian habitats, water quality and quantity, fish and wildlife species, and public safety and property. Standards are defined as a regulatory requirement that must be followed or achieved in the design and completion of developments (BC MWLAP 2004f). Best management practices are recommended methods or techniques that should be followed to ensure the standards are met and effects are mitigated (Table 13.2-1).

13.2.2 Land Management Plans

The Project is within the Regional District of Peace River (RDPR), and contains extensive areas of Crown land and areas subject to the Dawson Creek Land and Resource Management Plan (LRMP). Wildlife-related management objectives of the Dawson Creek LRMP are described in Table 13.2-2 (BC ILMB 1999). The LRMP covers an area of 2.9 million hectares of land between Fort St. John and Prince George, and is subdivided into 12 Resource Management Zones (RMZs). The Project License

Area overlaps with three of the RMZ's; the Major River Corridors RMZ (Murray River 3A, 3D subzones), the Foothills RMZ (Bullmoose Creek 5F and Mount Anderson 5D subzones), and the Alberta Plateau RMZ (Redwillow Creek 9G and Mt. Bennett 9H subzones).

Table 13.2-1. Wildlife Legislation, Regulation, Policy, Standards, and Guidelines

Name	Year	Type	Level of Government or Industry	Description
Migratory Birds Convention Act	1994	Act	National	This Act prohibits the killing of migratory birds or depositing harmful substances in areas frequented by migratory birds, and also protects their eggs and nests.
Species at Risk Act (SARA)	2002	Act	National	This Act offers legal protection and conservation of wildlife species in Canada. Species are identified as special concern, endangered, threatened, and extirpated; species are managed for conservation and/or recovery. The Act prohibits the identified wildlife from being harmed or harassed and the residence (nest or den) of the species from being damaged or destroyed. SARA applies to federal lands, unless the identified species is also protected under the *Migratory Birds Convention Act*; SARA would then apply to both federal and provincial lands.
Wildlife Act	1996	Act	Provincial	Multiple sections protect wildlife by outlining rules in regards to hunting, taking, trapping, wounding, and/or killing wildlife. Specifically, Section 34 of the Act protects birds, eggs, and occupied nests from possession, molestation, injury, or destruction.
Water Act	1996	Act	Provincial	This Act ensures that water quality, fish and wildlife habitat, and the rights of license users are not compromised.
Forest and Range Practices Act (FRPA)	2002	Act	Provincial	Wildlife Habitat Areas (WHAs) are designated by the Ministry of Forests, Lands and Natural Resource Operation (MFLNRO) and are associated with the Identified Wildlife Management Strategy under the provisions of the *Forest and Range Practices Act* (2004). The RSA overlaps one approved WHA for the Quintette caribou herd. The *Government Actions Regulation*, from the *Forest and Range Practices Act* (2004), outline the authority for establishing Ungulate Winter Ranges (UWRs). An order was given, establishing an UWR (U-9-002) for mountain goat and northern population of woodland caribou that overlap the RSA (BC MOE 2006).

(continued)

Table 13.2-1. Wildlife Legislation, Regulation, Policy, Standards, and Guidelines (continued)

Name	Year	Type	Level of Government or Industry	Description
Management Unit Regulation	2012	Regulation	Provincial	British Columbia is divided into 225 Wildlife Management Units (WMUs). The RSA overlaps within the Peace Zone Region 7: WMUs 7-20, 7-21, and minor portions of 7-22.
BC Environmental Assessment Guidelines for Grizzly Bears and Black Bears	2001	Guideline	Provincial	Guidelines for project reports, Environmental Assessment project applications and Cumulative Effects Analysis in regards to grizzly and black bears and their associated habitat.
Best Management Practices for Amphibians and Reptiles in Urban and Rural Environments in BC	2004	Guideline	Provincial	Guideline to maintain amphibian and reptile populations in areas of development.
Best Management Practices for Raptor Conservation during Urban and Rural Land Development in BC	2005	Guideline	Provincial	Guidelines to maintain raptors and raptor habitat in areas of development.
Develop with Care 2012: Environmental Guidelines for Urban and Rural Land Development in BC	2012	Guideline	Provincial	Guideline to maintain environmental values in areas of development.
Environmental Best Management Practices for Urban and Rural Land Development: Special Wildlife and Species at Risk	2004	Guideline	Provincial	Guideline to protecting species wildlife and species at risk in areas of development.
Migratory Birds Environmental Assessment Guide	1998	Guideline	Federal	Guideline focuses on migratory bird requirements.
Riparian Management Area Guidebook	1995	Guideline	Provincial	Guideline for forestry activity in riparian areas.
Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006	2006	Guideline	Industry	Guideline to maintain or enhance avian populations in areas of electric power networks.
Standards and Best Practices for Instream Works	2004	Guideline	Provincial	This guideline outlines applicable legislation and promotes the best practice for conducting activities.

(continued)

Table 13.2-1. Wildlife Legislation, Regulation, Policy, Standards, and Guidelines (completed)

Name	Year	Type	Level of Government or Industry	Description
Wetlands Environmental Assessment Guideline	1998	Guideline	Federal	Guideline that incorporates wetland policy and the ecosystem component from the CEAA (2012).
Wetland Ways: Interim Guidelines for Wetland Protection and Conservation in BC	2009	Guideline	Provincial	Guideline for development near wetlands.
Wildlife Guidelines for Backcountry Tourism/Commercial Recreation	2006	Guideline	Provincial	Guideline for maintaining wildlife populations and wildlife habitat when conducting backcountry tourism or commercial recreation.

Table 13.2-2. Wildlife Objectives of the Dawson Creek Land and Resource Management Plan

Wildlife-related Resource	Wildlife-related Management Objectives
General - biodiversity	• Conserve the biodiversity of natural ecosystems
Wildlife	• Sustain and manage wildlife habitat for red, blue, and yellow-listed species • Provide opportunities for the sustainable harvest of wildlife resources • Sustain and manage wildlife and critical wildlife to reduce wildlife-agriculture/range conflicts • Sustain and manage habitat for resident and migratory wildlife species
Trapping	• Recognize existing trapping tenures, and manage furbearer habitats and populations (considering enhancement at the landscape unit and operational levels) to provide long term opportunities for trapping • Recognize trapping and the use of trapping areas as a way of life and of special year-round cultural significance to First Nations
Guide Outfitting	• Sustain and manage existing guide outfitting opportunities
Access	• Plan and manage access to Crown land subject to the resource values and/or features identified for a respective RMZ using landscape unit level and operational planning • Maintain existing recreational access routes including specified and/or designated trails

The Foothills and Alberta Plateau RMZs falls under the General Resource Management provincial land use category, which includes lands:

- To be managed for a wide range of resource values;
- Where conflicts between land uses are managed in an effort to integrate resource development with environmental and conservation values; and
- Where investment in resource development and enhancement may be encouraged in areas with few land use conflicts.

The Major Rivers Corridor RMZ is designated as a Special Resource Management land use category that is further subdivided based on the major resource values with high priority in land and resource planning and development. These lands contain extractive resource values which may be of significant social and economic benefit to the province. Resource development is permitted but must consider and address all significant values identified. The intent is to assess risk and to adequately manage any conflict. The Major River Corridors category includes major river valleys that have significant fish and wildlife habitat, recreation, tourism, and scenic/visual quality values.

River riparian areas and river valleys provide important habitats and habitat connectivity for ungulates, furbearers, bears, and migratory songbirds. South and southwest facing slopes provide important habitat for ungulates. The river corridors are generally areas of higher natural biodiversity. An important landscape unit level requirement for maintaining biodiversity is to manage land and resource development to ensure there is connectivity across the landscape, especially between river valleys and upland areas. These are important travel routes for small mammals, ungulates, and carnivores.

13.3 REGIONAL OVERVIEW

This section provides an overview of wildlife and wildlife habitat associated with the Project and describes the following aspects:

- regional ecology;
- protected areas;
- wildlife habitats and development guidelines;
- species of conservation concern; and
- species of local interest.

13.3.1 Regional Ecology

The Murray River Project is located in the Rocky Mountain Foothills in northeastern British Columbia. In order to present the regional ecological context in which the Project resides, the area is described using the BC Ecoregional Classification system and Biogeoclimatic Ecosystem Classification (BEC) system (Demarchi 1996; Ministry of Forests and Range 2013). BEC uses the interactions of dominant vegetation, soils, and topography to identify geographic areas (biogeoclimatic zones and subzones) with a relatively uniform climate (Ministry of Forests and Range 2013). The BEC zones present within the RSA include Boreal White and Black Spruce (BWBS), Engelmann Spruce–Subalpine Fir (ESSF), Sub-Boreal Spruce (SBS), and Boreal Altai Fescue Alpine (BAFA). These BEC zones are illustrated in Figure 13.3-1; Table 13.3-1 lists each of the nine biogeoclimatic (BGC) labels presented in the figure. The majority (92%) of the RSA consists of forested BEC units. These BEC zones and sub-zones present in the RSA are further described in Section 11.3, Terrestrial Ecology Setting.

Figure 13.3-1

Biogeoclimatic Ecosystem Classification within the Regional Study Area

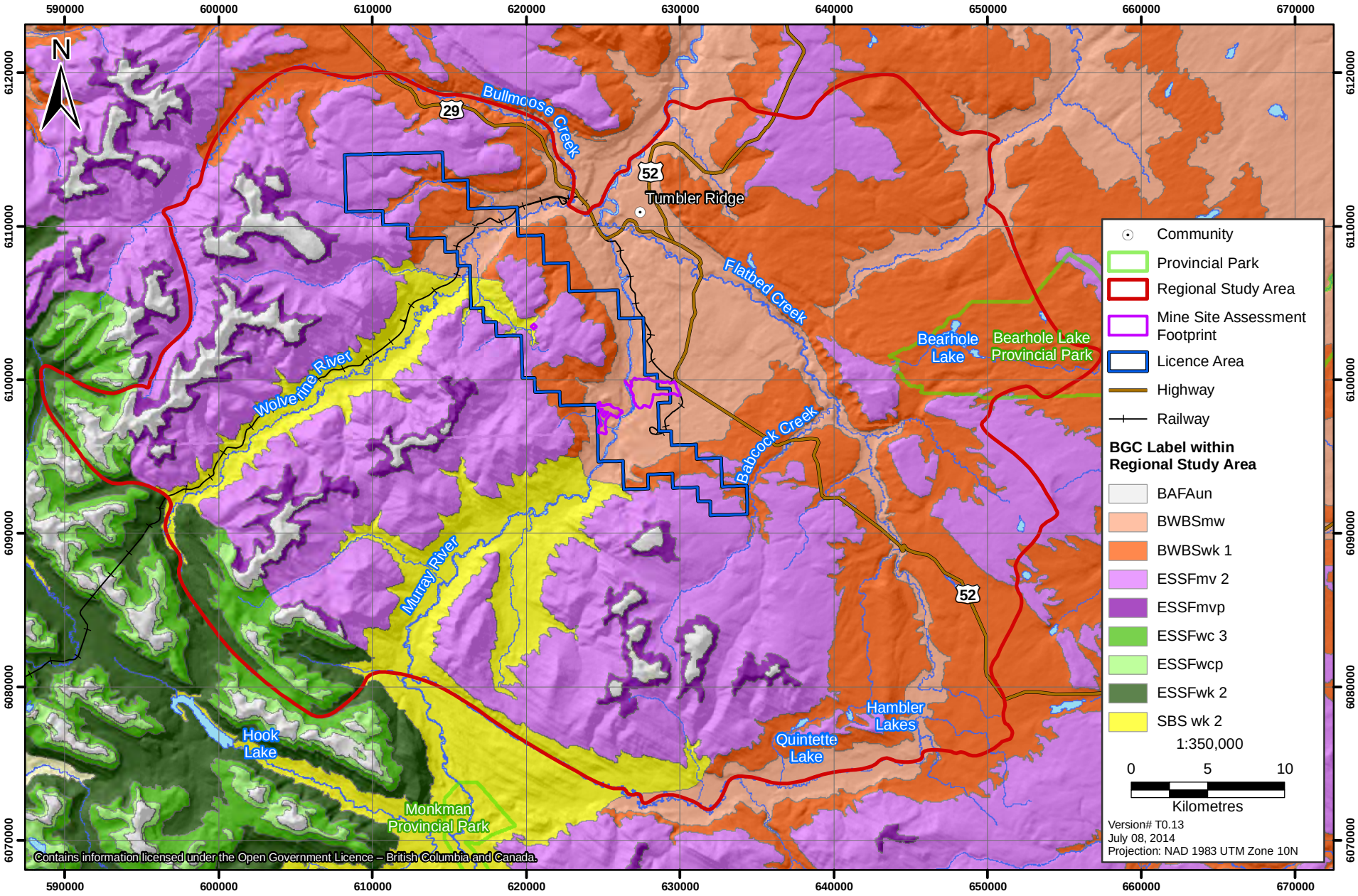


Table 13.3-1. Biogeoclimatic Ecosystem Classification Present in the RSA

BEC Unit	BGC Label	Description	Percent in RSA
Forested	ESSFmv 2	Bullmoose Moist Very Cold Engelmann Spruce-Subalpine Fir Variant	37%
	BWBSwk 1	Murray Wet Cool Boreal White and Black Spruce Variant	27%
	BWBSmw	Moist Warm Boreal White and Black Spruce Subzone	14%
	SBS wk 2	Finlay-Peace Wet Cook Sub-Boreal Spruce Variant	10%
	ESSFwc 3	Cariboo Wet Cold Engelmann Spruce-Subalpine Fir Variant	2%
	ESSFwk 2	Misinchinka Wet Cool Engelmann Spruce-Subalpine Fir Variant	2%
Parkland	ESSFmvp	Moist Very Cole Engelmann Spruce-Subalpine Fir Parkland	5%
	ESSFwcp	Wet Cold Engelmann Spruce-Subalpine Fir Parkland	<1%
Alpine	BAFAun	Undifferentiated Boreal Altai Fescue Alpine	3%

The Project RSA is within the Central Canadian Rocky Mountain Ecoregion. Ecoregions represent broad areas of major physiographic and minor macroclimatic variation. Within ecoregions, ecosections depict areas of minor physiographic and minor macroclimatic variation. This ecoregion includes the Rocky Mountains, straddling British Columbia and Alberta, and extends south into the United States (Nature Conservancy Canada 2013). Within this ecoregion, the Project area is situated within the Hart Foothills Ecosection, which is along the east side of the Rocky Mountains. Rounded mountains and foothills with wide valleys are found within the Central Canadian Rocky Mountain Ecoregion and Hart Foothills Ecosection; the mountains and foothills are lower than other ranges in ecoregions to the north or south (Demarchi 1996). Generally, the climate is relatively dry as a result of the Arctic air stalling in this area. The regional ecology in the RSA is further described in Section 11.3, Terrestrial Ecology Setting.

13.3.2 Protected Areas

There is one provincial protected area in the RSA; approximately one-third of Bearhole Lake Provincial Park (5,795 ha), which is east of Flatbed Creek, is within the RSA boundary (Figure 13.3-1). Bearhole Lake Provincial Park is approximately 14 km east of the Mine Site Assessment Footprint boundary. Within the park are the Kiskatinaw River headwaters and spruce forests (BC MOE 2013a). The area surrounding Bearhole Lake offers nesting habitat for trumpeter swans (*Cygnus buccinators*); in addition, winter ranges for low elevation caribou (*Rangifer tarandus*), moose (*Alces americanus*), and white-tailed deer (*Odocoileus virginianus*) are found within the provincial park (BC MOE 2013a).

13.3.3 Wildlife Habitats with Development Guidelines

A variety of wildlife habitats occur in the RSA that have been identified by provincial or scientific authorities as being important for wildlife in this area. Many of these habitats have development guidelines associated with them. These include: (1) sensitive habitats, (riparian, wetland, and alpine habitat); and (2) high-quality habitats and features, which consist of wildlife habitat areas (WHA) ungulate winter range (UWR), riparian management zones (RMZ), mineral licks, and movement corridors.

13.3.3.1 Sensitive Habitats

These habitats consist of vegetation communities and wildlife habitat that are sensitive to disturbances; sensitive habitats in the RSA include riparian and wetland ecosystem, alpine ecosystem, and old-growth forest (Figure 13.3-2).

Riparian and Wetland Ecosystems

Riparian habitats (including wetlands) provide high-quality denning and foraging habitat to a diverse wildlife community and serve as movement corridors for some wildlife species. The Dawson Creek LRMP has designated the Major River Corridor RMZ as a Special Management category and includes riparian areas along Murray River and the Redwillow Creek that feeds into the Kiskatinaw watershed. Approximately 8,849 ha of the Murray River RMZ is within the RSA; just under one-third of it overlaps the Local Study Area (LSA; Figure 13.3-2). One of the goals of the Major River Corridor RMZ is to decrease or eliminate, when possible, any negative impact on riparian areas (Ministry of Employment and Investment 1999). In addition, the RMZ that overlaps Wolverine River (Foothills RMZ) and another large RMZ within the RSA (Alberta Plateau RMZ) both focus on the value of corridors. Riparian habitat, specifically bogs, is known to be critical low-elevation caribou winter habitat in the Alberta Plateau RMZ (Ministry of Employment and Investment 1999). The Riparian Management Area Guidebook also provides suggested forestry practices for riparian and wetland ecosystems (MFLNRO 1995).

Alpine Ecosystems

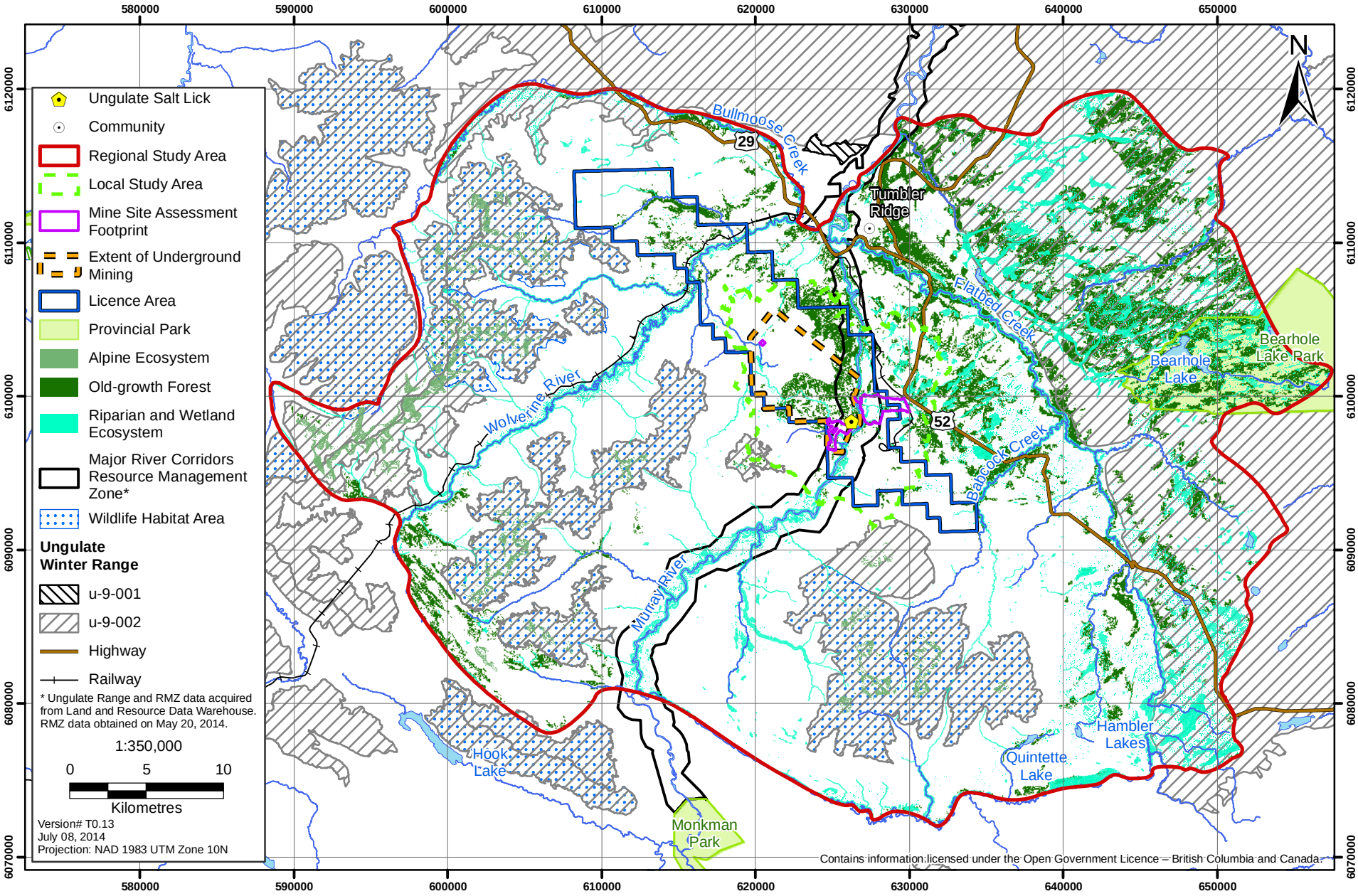
Alpine ecosystems are defined by a general absence of trees due to climate and soil conditions associated with increases in elevation. Common ecosystems include heath heather, herb meadows and krummholz (stunted trees). Non-vegetated areas, such as rock outcrops and barren soil, are common. Alpine vegetation is considered sensitive because disturbed vegetation may not recover to pre-disturbance levels, even in the long-term (Frank and del Moral 1986; Forbes, Ebersole, and Strandberg 2001; Mingyu et al. 2009).

Alpine ecosystems are important seasonal habitat, providing forage, breeding areas, and escape terrain for wildlife from predators and insects. For example, grizzly bear forage extensively in alpine and meadow areas in the summer and fall, and mountain goats use alpine areas for both winter habitat and movement corridors (McNay et al. 2009). Alpine ecosystems in the RSA are illustrated on Figure 13.3-2.

Old-growth Forests

Old-growth forests are considered sensitive habitats because of their structural diversity, supporting a wide variety of plant and animal species, such as winter habitat for ungulates through provision of thermal and snow interception cover, denning habitat for bears, roosting habitat for bats, nesting habitat for various bird species, and habitat for furbearers, such as American marten (*Martes americana*). There is 114,537 ha of old growth forest within the Dawson Creek LRMP; while over half of this area is within the Timber Harvesting Land Base, a little over one-third of old-growth forest is in exclusion areas, such as inoperable areas (Ministry of Employment and Investment 1999). Of the old-growth forest area in the LRMP, a little over a quarter is found in the RSA (30,556 ha). A total of 188.8 ha are within the LSA.

Figure 13.3-2
Sensitive and High-quality Wildlife Habitats



Old growth within the BWBS and SBS BEC zones in moist and nutrient rich areas provide valuable habitat for wildlife. Mature and old forested riparian habitat, particularly cottonwood, supports black bear dens, fisher dens, and provides nesting, roosting, and feeding habitat for various other species. Project-related alterations to old-growth forests are addressed under the forested ecosystem valued component; it is evaluated in detail in Chapter 11, Assessment of Terrestrial Ecology Effects.

Some old-growth areas are protected through the establishment of Old Growth Management Areas (OGMAs), which are permanent old-growth retention areas, reserved from forest development modification such as clearing, harvesting, and activities that may cause blow-down within the boundaries of the OGMA. These areas are established by the BC Ministry of Environment (MOE) through consultation with Aboriginal groups, the BC MFLNRO, and other individuals. OGMAs are a component of most integrated resource management plans, and they contain legal objectives that are enforceable under the *Forest Range and Practices Act* (2004) and the *Land Act* (1996a). In 1999, the Landscape Unit Planning Guide identified retention of old-growth forest as a priority for biodiversity planning (BC MOF and BC MELP 1999). Seventeen OGMAs that cover an expanse of 15,195 ha are present within the RSA; one of them overlaps the LSA (60.7 ha).

13.3.3.2 High-quality Wildlife Habitats and Features

High-quality wildlife habitat and features have been identified by provincial legislation or LRMPs, and may have associated management objectives. These habitats include wildlife habitat areas (WHA) ungulate winter range (UWR), riparian management zones (RMZ)ungulate mineral licks, and movement corridors (Figure 13.3-2).

Wildlife Habitat Areas

Wildlife habitat areas (WHAs) represent wildlife habitat considered for management under the Identified Wildlife Management Strategy (BC MWLAP 2004d). The WHAs are mapped to conserve those habitats considered most limiting to a given Identified Wildlife. The Murray River RSA overlaps an approved WHA for woodland caribou; WHA polygons 9-059 to 9-066 (Figure 13.3-2). Approximately 84% of the calving and rutting grounds identified for the Quintette herd are within the RSA (Appendix 13-A).

Ungulate Winter Ranges

Ungulate winter ranges (UWRs), like WHAs, are established through a land use planning process and are defined by the BC MOE under the authority of sections 9(2) and 12(1) of the *Government Actions Regulation* (BC Reg. 582/2004) and the *Forest and Range Practices Act* (2004). UWRs ensure environmental sustainability across a landscape by: (1) identifying suitable habitat, and (2) integrating habitats that provide a variety of functions, including considerations for habitat interspersion (BC MOE 2013e). UWRs have legislated management strategies that include work timing windows and set-back distances for road construction and aircraft flying (BC MOE 2006).

The RSA overlaps one approved UWR (U-9-002) for mountain goats and caribou (BC MOE 2006); approximately 16% of this identified area is located within the RSA (85,374 ha; (Figure 13.3-2). This UWR contains both high and low elevation winter ranges. Within the RSA, less than half of the

area (45%; 38,022 ha) is high elevation range for both ungulate species. The remaining area is low elevation winter range for caribou (47,352 ha).

Resource Management Zone

The Dawson Creek LRMP is divided into RMZs which are grouped into five land use categories based on the major resource values; Enhanced Resource Development, General, Protected Areas, Settlement/Agriculture, and Special. The majority of RMZs within the RSA are placed within the General Resource Management category. Three General and one Special Resource Management categories overlap with the LSA. The Special Resource Management category (Major River Corridor) includes major river valleys, such as Murray River, that offer significant wildlife habitat as well as fish habitat, recreation, tourism and scenic qualities (Figure 13.3-2). Resource development is permitted in all categories, with the exception of Protected Areas.

Ungulate Mineral Licks

Natural mineral licks are habitat features that are important for maintaining the health of ungulates. Ungulates use these features for mineral supplementation mainly during the summer (R.V. Rea, Hodder, and Child 2004; Ayotte, Parker, and Gillingham 2008), but may also use them in early spring or during the winter (e.g., moose and elk; Couturier and Barrette 1988; Ayotte, Parker, and Gillingham 2008). A mineral lick may be designated as a Wildlife Habitat Feature and managed under the *Forest and Range Practices Act* (2004). One mineral lick was observed during baseline surveys in the LSA just north of the Mine Site Assessment Footprint along the west side of Murray River (Figure 13.3-2 and Appendix 13-A). The importance of and frequency of use at this mineral lick by ungulates in the LSA and RSA is unknown. First Nations traditional knowledge indicates that mineral licks are heavily used in the general region surrounding the Project, and are important to various ungulate species, particularly moose (Olson and Bates, 2014). The presence of active game trails and the location of this lick in the Murray River corridor suggest it may receive significant use from moose, elk, and deer.

Movement Corridors

Movement corridors connect habitats that are exploited during different times of the year, while movements within daily or seasonal ranges may also occur along specific routes (e.g., pathways to mineral licks, routes between western toad winter hibernation sites and spring breeding sites). Corridors increase animal movement between habitat patches, which can facilitate healthy population sizes, enable gene flow, and maintain biodiversity (Haddad *et al*. 2003). Migratory movements of moose, for example, often follow traditional routes, with animals using the same annual movement corridors (Bowyer, Ballenberghe, and Kie 2003). Moose, elk, and deer likely use the major drainages in the RSA, such as the Murray River, Wolverine River, and Flatbed Creek drainages and the landscape features (e.g., saddles and riparian areas) which connect these valleys, when moving between their seasonal ranges. Observations of mountain goat, caribou, and deer on higher elevation areas also suggest that these features facilitate movement between watersheds.

13.3.4 Species of Conservation Concern

Species of conservation concern include species or populations federally listed as Endangered, Threatened, or of Special Concern and provincial species listed as Red (endangered or threatened) and Blue (species of concern). The *Committee on the Status of Endangered Wildlife in Canada* (COSEWIC) designates the conservation status of species and populations for the *Species at Risk Act* (SARA; 2002). Provincially, the species are designated by the BC MOE under the *Wildlife Act* (1996b). Overall, 30 species of conservation concern were detected within the RSA or were considered as likely occurring within the RSA, based on species distribution maps (Table 13.3-2). Three species that were confirmed within the RSA during baseline studies are listed on Schedule 1 of SARA: olive-sided flycatcher, peregrine falcon, and western toad. Canada warbler and rusty blackbird, also listed on Schedule 1 of SARA, were observed during a roadside survey in TFL 48 (Westcam 2008) but not during baseline studies. However, it is likely that these two species also occur in the Murray River area. Seven survey transects were conducted in TFL 48; one overlaps the RSA and LSA, three are approximately 40-70 km NW of the RSA, and three are approximately 90-120 km NW of the RSA.

13.3.5 Species or Groups of Local Interest

Some wildlife species and groups within the LSA and/or RSA are identified as regionally important for biological, economic, social, or cultural reasons (Table 13.3-3). In addition, Identified Wildlife under the Government of BC Identified Wildlife Management Strategy (IWMS) were included as species of local interest, as they are species that have been acknowledged as important to regional stakeholder groups such as First Nations, government agencies, and other regional community members. Regionally important species or groups have been identified by biologists, Aboriginal peoples, local community members, and from information included in land and resource management documents, such as the LRMPs (see Section 13.2.2 for details of the land management plans).

13.4 HISTORICAL ACTIVITIES

Several historic and current human activities have occurred in the RSA. These include mineral and coal production, wind power projects, forestry, back country recreation, hunting, trapping and road and rail development. Potential effects of interactions of wildlife with other proposed or existing projects are discussed in the cumulative effects assessment section (Section 13.10).

13.4.1 Past and Present Industrial Projects

There are four past and current industrial projects in the RSA; Quintette Coal Mine, Bullmoose Coal Mine, Wolverine Coal Mine, and the Quality Wind Project.

Table 13.3-2. Species of Conservation Concern Likely or Probable to Occur within the Project Area

Common Name	Scientific Name	Likelihood of Occurrence in RSA[1]	Identified during Baseline Studies[2]	BC List	Identified Wildlife[3]	COSEWIC[4]	SARA[5]	Migratory[6]
Ungulates								
Caribou (central mountain population; Quintette)	*Rangifer tarandus*	P	Y	Red	Yes	E (2014)		
Bears								
Grizzly bear	*Ursus arctos*	L	Y	Blue	Yes	SC (2012)		
Furbearers								
Fisher	*Martes pennanti*	L		Blue	Yes	-		
Wolverine, *luscus* ssp.	*Gulo gulo luscus*	L		Blue	Yes	SC (2014)		
Small Mammals - Bats								
Little brown myotis	*Myotis lucifugus*	P	P	Yellow		E (2013)		
Northern myotis	*Myotis septentrionalis*	P	P	Blue		E (2013)		
Raptors								
Broad-winged hawk	*Buteo platypterus*	P		Blue		-		
Northern goshawk, *atricapillus* ssp.	*Accipiter gentilis atricapillus*	L	Y	Blue		NAR (1995)		
Peregrine falcon, *anatum* ssp.	*Falco peregrinus anatum*	L	Y	Red		SC (2007)	1 (2012)	
Short-eared owl	*Asio flammeus*	L		Blue	Yes	SC (2012)	1 (2012)	
Songbirds								
Barn swallow	*Hirundo rustica*	L	Y	Blue		T (2011)		Yes
Bay-breasted warbler	*Setophaga castanea*	P		Red	Yes	-		Yes

[1] *P – Probable to occur in RSA; L – likely to occur in RSA.*

[2] *P – possible observation during baseline studies; Y – definite observation during baseline studies.*

[3] *Wildlife Species that have been identified by an Identified Wildlife Management Strategy (IWMS) through the Ministry of Environment in partnership with the Ministry of Forests and Range (BC MWLAP 2004d). The IWMS provides direction, policy, procedures and guidelines for managing Identified Wildlife to minimize the effects of forest and range practices on Identified Wildlife situated on Crown land and to maintain their limiting habitats throughout their current ranges and, where appropriate, their historic ranges.*

[4] *E – Endangered; T – Threatened; SC – Special Concern; C – Candidate; NAR – Not At Risk.*

[5] *1 – Schedule 1*

[6] *As per the* Migratory Birds Convention Act *(1994a).*

(continued)

Table 13.3-2. Species of Conservation Concern Likely or Probable to Occur within the Project Area (completed)

Common Name	Scientific Name	Likelihood of Occurrence in RSA[1]	Identified during Baseline Studies[2]	BC List	Identified Wildlife[3]	COSEWIC[4]	SARA[5]	Migratory[6]
Songbirds *(cont'd)*								
Black-throated green warbler	*Setophaga virens*	L	Y	Blue	Yes	-		Yes
Canada warbler	*Cardellina canadensis*	P	P	Blue		T (2008)	1 (2010)	Yes
Cape May warbler	*Setophaga tigrina*	L		Red	Yes	-		Yes
Common nighthawk	*Chordeiles minor*	L		Yellow		T (2007)	1 (2010)	Yes
Connecticut warbler	*Oporornis agilis*	P		Blue	Yes	-		Yes
Olive-sided flycatcher	*Contopus cooperi*	L	Y	Blue		T (2007)	1 (2010)	Yes
Rusty blackbird	*Euphagus carolinus*	L	P	Blue		SC (2006)	1 (2009)	Yes
Waterbirds								
American bittern	*Botaurus lentiginosus*	L		Blue		-		Yes
Clark's grebe	*Aechmophorus clarkii*	L	P	Red		-		Yes
Harlequin duck	*Histrionicus histrionicus*	P	Y	Yellow		-		Yes
Horned grebe	*Podiceps auritus*	L	Y	Yellow		SC (2009)		Yes
Red-necked phalarope	*Phalaropus lobatus*	L	Y	Blue		-		Yes
Short-billed dowitcher	*Limnodromus griseus*	P		Blue		-		Yes
Surf scoter	*Melanitta perspicillata*	L	Y	Blue		-		Yes
Western grebe	*Aechmophorus occidentalis*	P	Y	Red		SC (2014)		Yes
Amphibians								
Columbia spotted frog	*Rana luteiventris*	L	Y	Yellow		NAR (2000)		
Western toad	*Anaxyrus boreas*	L	Y	Blue		SC (2012)	1 (2005)	

[1] *P – Probable to occur in RSA; L – likely to occur in RSA.*

[2] *P – possible observation during baseline studies; Y – definite observation during baseline studies.*

[3] *Wildlife Species that have been identified by an Identified Wildlife Management Strategy (IWMS) through the Ministry of Environment in partnership with the Ministry of Forests and Range (BC MWLAP 2004d). The IWMS provides direction, policy, procedures and guidelines for managing Identified Wildlife to minimize the effects of forest and range practices on Identified Wildlife situated on Crown land and to maintain their limiting habitats throughout their current ranges and, where appropriate, their historic ranges.*

[4] *E – Endangered; T – Threatened; SC – Special Concern; C – Candidate; NAR – Not At Risk.*

[5] *1 – Schedule 1*

[6] *As per the* Migratory Birds Convention Act *(1994a).*

Table 13.3-3. Wildlife Species or Groups of Regional Interest within the Project RSA

Species Group/Name (Scientific Name)	Reason of Interest
Ungulates	
Caribou (*Rangifer tarandus*)	The Dawson Creek LRMP provides direction to manage critical low and high elevation caribou habitat by incorporating it into landscape unit level and including in operational planning (BC ILMB 1999). Identified as culturally significant to First Nations.
Elk (*Cervus elaphus*)	A socio-economic and biological important species to the region, their winter range can receive protection as a UWR. Elk have been identified as culturally important to First Nations and as a key indicator species in the Dawson Creek LRMP (BC ILMB 1999).
Moose (*Alces americanus*)	Identified as culturally significant and hunted by First Nations. Economically important species to resident hunters and guide outfitters. Identified as an important species requiring increased management consideration by the Dawson Creek LRMP (BC ILMB 1999).
Mountain goat (*Oreamnos americanus*)	UWR for goat overlaps the RSA. Identified as a culturally significant and hunted species by Aboriginal peoples. Identified as an important species requiring increased management consideration by the Dawson Creek LRMP (BC ILMB 1999).
Bears	
Grizzly bear (*Ursus arctos*)	A species at risk and a species of provincially high profile with continued emphasis on its conservation. It is culturally important to First Nations. It has received prominent consideration in the Dawson Creek LRMP (BC ILMB 1999) for the RSA and will continue to be emphasized as a species warranting enhanced consideration to integrate its conservation with development.
Furbearers	
Fisher (*Martes pennanti*)	A valuable furbearer species that requires additional management consideration because it is provincially blue-listed and an Identified Wildlife (BC MWLAP 2004d; BC CDC 2013). Also identified as an important species to surrounding Aboriginal groups.
Marten (*Martes americana*)	Identified as a culturally significant species and trapped by First Nations. Economically important furbearer to local trappers. Identified as an important species requiring increased management consideration by land management plans including the Dawson Creek LRMP (BC ILMB 1999).
Wolverine (*Gulo gulo luscus*)	Identified as an important species to surrounding Aboriginal groups. An Identified Wildlife species that is sensitive to disturbances such as roads and recreational activities (Weir 2004). Increasing emphasis from regulators to include inventory of this species to attain a better understanding locally for assessment of future developments.
Small Mammals	
Bats	There is a lack of regional knowledge for this wildlife group and their ability to habituate to anthropogenic structures.
Raptors	
Raptors	Nests and certain raptor species are protected under the *BC Wildlife Act* (1996). Culturally significant species to First Nations are included in this group. Identified as important wildlife group requiring increased management consideration (Best Management Practices for Raptor Conservation during Urban and Rural Land Development in British Columbia; BC MOE 2005b).

(continued)

Table 13.3-3. Wildlife Species or Groups of Regional Interest within the Project RSA (completed)

Species Group/Name (Scientific Name)	Reason of Interest
Songbirds	
Songbirds (black-throated green warbler as a representative species) (*Setophaga virens*)	Component of biodiversity, individuals, eggs, and active nests protected under the *Migratory Birds Convention Act* (1994) and *BC Wildlife Act* (1996). Warblers in general have been identified as a key indicator species in the Dawson Creek LRMP (BC ILMB 1999). Specific warbler species are Identified Wildlife (BC MWLAP 2004d); bay-breasted warbler (*Setophaga castanea*), Cape May warbler (*Setophaga tigrina*), and Connecticut warbler (*Oporornis agilis*).
Waterbirds	
Waterfowl	Individuals, eggs, and active nests protected under the *Migratory Birds Convention Act* (1994) and *BC Wildlife Act* (1996). Some species, such as swans, are important to surrounding Aboriginal groups. Important nesting habitat for trumpeter swans is offered at Bearhole Lake and the surrounding area (BC MOE 2013a). Waterfowl are also hunted by the Saulteau and McLeod Lake First Nations.
Amphibians	
Amphibians (western toad as a representative species) (*Anaxyrus boreas*)	Listed as a species of Special Concern under Schedule 1 of *SARA* (2002) and an important indicator species.

The Quintette Coal Mine, about 20 km south of Tumbler Ridge, was an open pit mine that operated between 1982 and 2000. The mine included access/haul roads, pits and spoils areas, transmission line, processing plant, storage and load-out facilities, offices and maintenance facilities, a sewage treatment facility, tailings facility, diversion ditches, and settling ponds. The mine consisted of five open pits in three discrete areas: Sheriff (Wolverine and Mesa Pits), Frame (Shikano Pit) and Babcock (Windy and Window Pits). Mine permits for the Wolverine and Mesa Pits were issued in December 1982 and mining commenced from 1983 until 1998 (Wolverine) and 2000 (Mesa). Raw coal was transported via an overland conveyor from the Mesa and Wolverine Pits to the Quintette plant site for processing. During the closure of the mine, mobile equipment was removed and the majority of open pits, waste rock spoils, and tailings facilities were reclaimed. A feasibility study was completed in 2012 to re-open the mine; coal production was expected in the first half of 2014, but the project has been put on hold (Teck 2014). The re-establishment of the coal mine would involve an original pit and the development of a new pit to produce an annual rate of 3 Mt of coal (BC MEMRCR 2003). In addition, a stockpile, overland conveyor, transmission lines, water management facilities, haul roads, and spoil areas will be constructed (Teck 2014). The mine will be accessed via existing Quintette mine road.

The Bullmoose Coal Mine operated from 1983 to 2003 and was the largest open pit coal mine at the time, producing about 3 million tons of metallurgical coal. The 1.7-million-tonne-per-year operation consisted of an open-pit mine, a plant facility in the Bullmoose Creek valley below the mine, and a separate rail loadout facility on the B.C. Rail branchline.

The Wolverine Coal Mine is approximately 10 km west of the Project. The coal mine has been in operation since 2006. It has a surface mine complex, underground mine, processing/load-out facility, and general facilities.

The Quality Wind Project is approximately 20 km northeast of the Project and has been in operation since 2012 (Capital Power 2013). This project partially overlaps the RSA and is the only wind farm within the RSA.

13.4.2 Forestry

Forest harvesting within the RSA is part of the Dawson Creek TSA and has fluctuated significantly in the recent years due to prevailing economic conditions. Figure 13.4-1 illustrates past, present, and possible future cutblock locations in relation to the RSA. Historical harvesting activities within the RSA were concentrated south of Tumbler Ridge, along or near Murray River, and along Wolverine River. Currently, harvesting is also occurring along the Wolverine River at and near the Wolverine Coal Mine area. In addition, the Quintette (Babcock) Coal Mine area and to the south, near the Tumbler Ridge Wind Energy Project, and near Tumbler Ridge are currently being harvested. Past and current harvest within the RSA overlaps with UWR and WHA. There is also increased forestry activity outside of the RSA to the north and northwest. Location of forest tenures are illustrated in Figure 16.5-7 in the Land Use Effects Assessment section.

13.4.3 Recreational Activities

Recreation activities that occur within the RSA include backcountry and eco-adventure tourism, guide-outfitting, hiking, white-water rafting, cross-country skiing, camping, hunting, and fishing. Tourism is becoming increasingly important within the RSA (Norton 2006). The nearest campground is 9.5 km north from the Project (near Tumbler Ridge). Areas used for winter activity (particularly snowmobiling) at times overlap UWRs. River boating, use of boats to facilitate fishing or hunting, and canoeing/kayaking occurs along the major rivers in the RSA such as Murray River and Wolverine River. It is common for people to travel Murray River by boat to visit Kinuseo Falls.

13.4.4 Fur Harvest

There are ten trapline tenures within the RSA; four in WMU 7-20, five in WMU 7-21, and one in WMU -7-22 (see Figure 16.5-6 in Section 16 Land Use Effects Assessment). Four of these are within the License Area, and two of these overlap the Mine Site Assessment Footprint. Two trapline cabin Crown Land tenures are located within the License Area; an additional eight cabin tenures are within the RSA. Ten species are commonly harvested on these traplines; beaver (*Castor canadensis*), coyote (*Canis latrans*), fisher, lynx (*Lynx canadensis*), American marten, otter (*Lontra canadensis*), squirrels (*Tamiasciurus* spp.), weasels (*Mustela* spp.), wolverine (*Gulo gulo*), and wolves (*Canis lupus*).

13.4.5 Wildlife Hunting

The province is divided into 225 Wildlife Management Units (WMUs). Approximately three-quarters of the RSA is within WMU 7-21, west of Highway 52 and approximately one-quarter of the RSA overlaps WMU 7-20 which is east of Highway 52. Less than one percent of the RSA is in WMU 7-22, located along the western RSA boundary.

Hunting, which has historically occurred and is currently occurring in the area associated with the Project, can affect population sizes, age ratios, sex ratios, sizes, and behaviours of harvested populations and may have effects on wildlife populations in the LSA and RSA. Wildlife species

currently harvested in the RSA include elk, moose, mule deer (*Odocoileus hemionus*), white-tailed deer, black bear, cougar (*Puma concolor*), wolf, grouse, ptarmigan, and waterfowl. The Fish, Wildlife and Habitat Management Branch collects and aggregates harvest data for each WMU. Data collected from 1980 to 2004 shows non-resident harvest in the RSA primarily concentrated on black bear and moose in all WMUs. Resident harvest in the region focused primarily on moose. Four guide-outfitting tenures overlap the RSA; they target black bear, elk, moose, cougar, and wolves. Harvest rates by recreational hunters, including both guided and resident hunters, are regulated by a permitting and licensing system that is administered by the Province of BC. The nearest hunt camp is 26 km west of the Project.

A moose population assessment was conducted in 2006 within WMU 7-21, which covers three-quarters of the RSA. The density of moose in the WMU was estimated to be approximately 0.3 moose per km^2 (Rowe 2008). The population size and sex ratios were found to be similar to previous studies conducted in 1998 and 2003 (Section 13.5.3.1).

13.4.6 Aboriginal Harvest

13.4.6.1 McLeod Lake Indian Band

The main community of McLeod Lake Indian Band (MLIB) is located outside of the RSA, approximately 125 km west of the Project. Hunting, trapping, and fishing are culturally and economically significant for the MLIB. Historically, the MLIB hunted and trapped in the Parsnip River, Nation River, Carp Lake, and Nation Lake areas (Chapter 16). Recently, the area south of Peace River between the Halfway and Moberly River confluences has been hunted for ungulates and waterfowl, as well as the Del Rio area (Rescan 2013b); neither area overlaps the RSA.

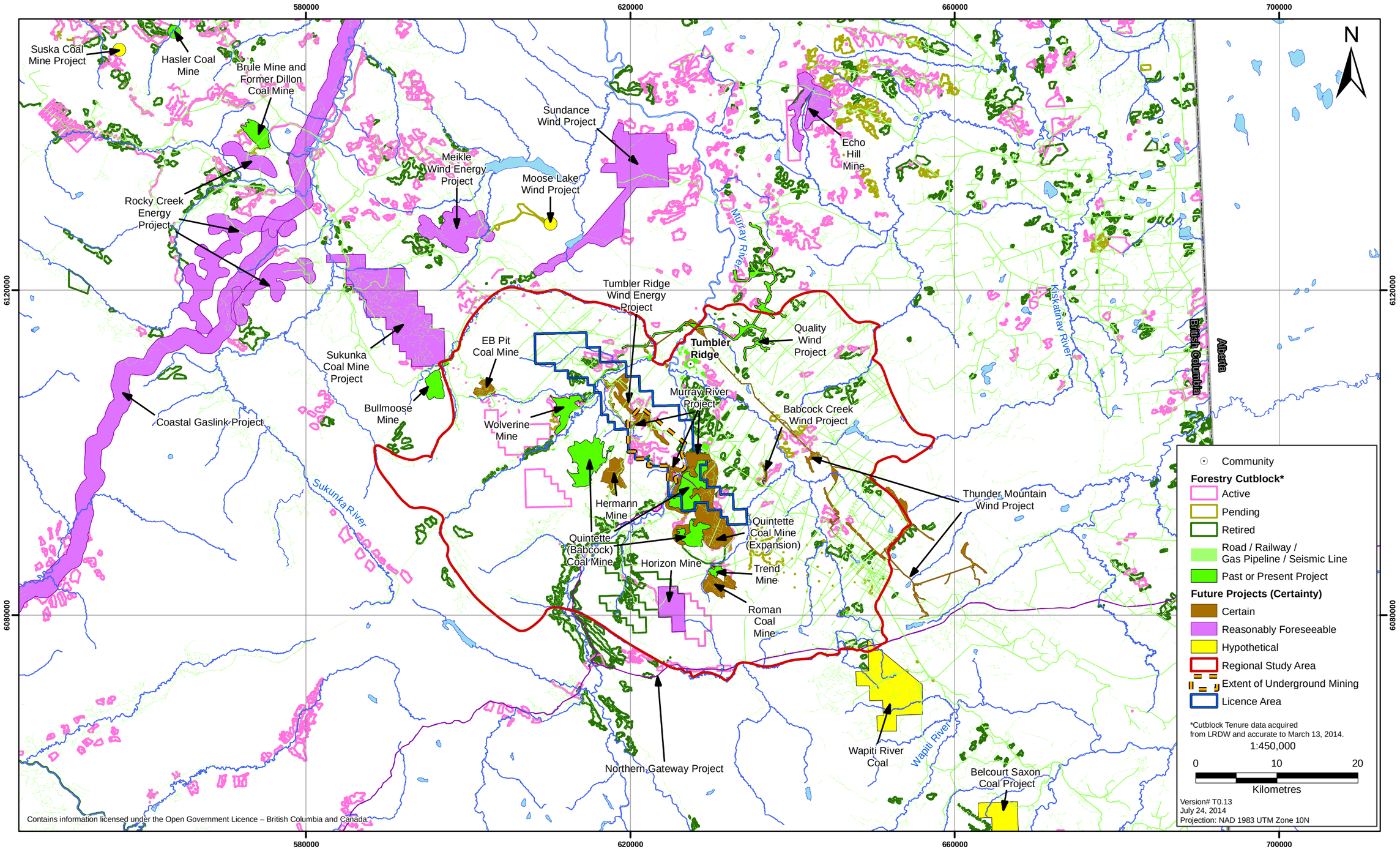
13.4.6.2 Saulteau First Nations

Saulteau First Nations (SFN) community is located at East Moberly Lake, approximately 105 km northwest of the Project, outside of the RSA. Hunting, trapping, and fishing are culturally and economically significant for the SFN. Historically, SFN have hunted and trapped south of the Peace River and east of the Rocky Mountains; currently, areas north of the reserve surrounding the Moberly and Pine Rivers are used for hunting (Chapter 16). While both hunting and trapping have decreased by residents within the Saulteau community, the SFN had a higher percentage of people that hunt and trap compared to other BC First Nations (Rescan 2013b). The SFN traditional use area overlaps with the RSA and a small portion of the northwest LSA boundary.

13.4.6.3 West Moberly First Nations

West Moberly First Nations (WMFN) is located on the west end of Moberly Lake, approximately 105 km northwest of the Project outside of the RSA. Activities such as hunting, trapping, and fishing, remain culturally and economically significant for WMFN (PMT SRMP 2006). The WMFN traditional use area includes the foothills and Rocky Mountains, and stretches as far westward as the Ospika River (Chapter 16). This traditional use area includes the northwest corner of the LSA and overlaps the RSA (Rescan 2013b).

Figure 13.4-1
Industrial and Forestry Activity near the Project Area



13.4.6.4 Métis

The Kelly Lake Métis community is located outside of the RSA, approximately 65 km northeast of the Project. The community is an important centre for residents accessing traplines and hunting areas (Chapter 16). The Kelly Lake trapping region overlaps a southeast portion of the LSA and the RSA (Rescan 2013b).

13.5 BASELINE STUDIES

Baseline studies were conducted to characterize wildlife presence and distribution within the LSA and RSA, and to inventory habitat for the wildlife Valued Components (VCs) concerned. Baseline surveys were completed during 2010 to 2013. This included an examination of current wildlife land use management objectives and existing wildlife inventories, identification of species of conservation concern, field inventories, and habitat suitability modelling. An initial series of wildlife Valued Components and methods for wildlife baseline surveys were developed in 2009. Wildlife VCs selected for baseline surveys included caribou (*Rangifer tarandus*), mountain goat (*Oreamnos americanus*), bats, furbearers, raptors, waterbirds, songbirds, and western toad (*Anaxyrus boreas*). Habitat suitability models were developed for seven species by Environmental Dynamics Inc.; woodland caribou (*Rangifer tarandus caribou*), Rocky Mountain elk (*Cervus canadensis nelsoni*), mountain goat, moose (*Alces americanus*), grizzly bear (*Ursus arctos*), fisher (*Pekania pennanti*), and black-throated green warbler (*Dendroica virens*). Wildlife habitat was mapped within the study areas according to provincial standards, were field evaluated, and were conducted at an appropriate scale as determined regionally for each wildlife species (RIC 1999a). The Wildlife Baseline Report (Appendix 13-A) and the Habitat Suitability Reports (Appendix 13-B and 13-C) provide details on methods and results for studies conducted for the Murray River Project.

13.5.1 Data Sources

A review of available data and literature was conducted to identify current best practices for wildlife inventory, existing species information, and past environmental studies that have been conducted in the Project area. This provided existing information for wildlife and wildlife habitat in the RSA, supplementing the wildlife field program. A combination of online scientific journals, online provincial databases, online report catalogues, internet tools (including iMap, SPI, Ecocat etc.), the provincial Fur Harvest Database, and information provided directly by regional wildlife inventory specialists, were reviewed and are summarized in Table 13.5-1.

Potentially occurring species at risk were identified from *SARA* (2002) and the BC Conservation Data Centre (BC CDC 2013). The Dawson Creek LRMP (BC ILMB 1999; Ministry of Employment and Investment 1999) provided existing information and data for the RSA. More information on relevant LRMPs is provided in Section 13.2.2. Habitat mapping has been conducted for woodland caribou, elk, mountain goat, moose, grizzly bear, fisher, and black-throated green warbler by EDI (EDI 2012).

Table 13.5-1. Data Sources Used to Supplement the Murray River Coal Project Wildlife Baseline Studies

Data Source	Data
BC MFLNRO Fish and Wildlife Branch (BC MFLNRO 2013) and BC MOE Ecosystem Branch (BC MOE 2013c)	Provides harvest data from provincial WMUs, and manages and provides direction to LRMPs.
iMapBC (GeoBC 2011)	Spatial information tool that identifies presence and locations of wildlife in an area through occurrence reports and telemetry locations; helps identify important wildlife habitat, such as UWRs and WHAs.
Ecological Reports Catalogue (EcoCat; BC MOE 2010a)	Provides access to a database of published wildlife research reports from across the province.
Wildlife Species Inventory database (BC MOE 2013d)	Maintains a database for submitting information from wildlife inventory studies in BC in the form of reports and datasets. Completed datasets and reports are available to the public using the Species Inventory Web Explorer.
BC Conservation Data Centre database (BC CDC 2013)	Online database that collects and disseminates information on plants, animals, and ecosystems (ecological communities) at risk in BC. This information provides a centralized and scientific source of information on the status, locations, and level of protection of these organisms and ecosystems (BC CDC 2013).

13.5.2 Baseline Study Area

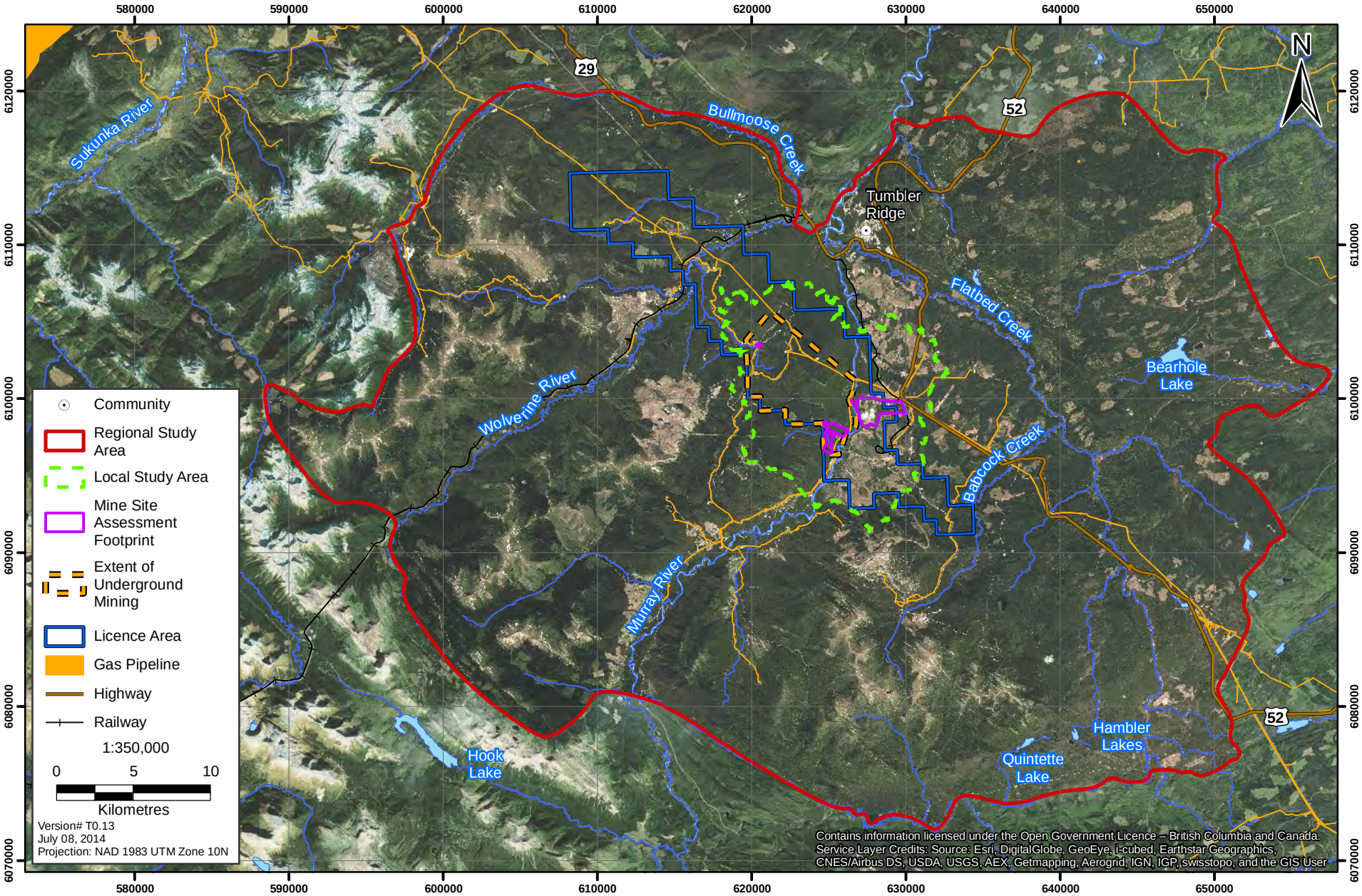
Wildlife baseline information is presented for both the local study area (LSA) (12,093 ha) and regional study area (RSA; 277,616 ha). The LSA and RSA defined the area for wildlife baseline studies; the LSA was modified in extent for the effects assessment when infrastructure layout was confirmed (Figure 13.5-1). The baseline RSA was delineated to reflect the area anticipated to provide habitat for wildlife that may come in contact with proposed Project infrastructure during the course of a season or lifetime. Ecological factors such as height of land and watershed boundaries, which can act as barriers to movement, were considered when selecting the RSA boundary. Species information, such as home range, habitat use, and seasonal movement patterns, were also considered. Sufficient area was included beyond the influence of the Project for future monitoring and the effects assessment.

The baseline LSA includes an area surrounding the proposed Project infrastructure where direct effects from the Project may occur. This boundary has also been developed following natural terrain and drainage boundaries in order to be ecologically relevant. The LSA boundaries for baseline studies were designed to incorporate a large area around proposed infrastructure to account for minor changes in infrastructure design and placement for the Project.

Details on the boundaries of the effects assessment LSA and RSA and rationale for the extent of the boundaries are presented in Section 13.6.2.

Figure 13.5-1

Regional Study Area and Local Study Area for Wildlife Baseline Studies



13.5.3 Methods of Wildlife Inventory and Habitat Suitability

A range of methods for the Project were used for wildlife studies, including a detailed literature review and baseline field surveys. Surveys were conducted on three wildlife groups during 2010 to 2013; mammals, birds, and amphibians. Surveys for mammals surveys focused on species of conservation concern or of social, economic, or biological importance, and which are expected to occur in the RSA. Specifically, baseline studies focused on ungulates, bears, furbearers, and bats. Studies were designed to collect baseline information on species presence and distribution. Avian baseline surveys were conducted for terrestrial and riparian-dwelling raptors, waterbirds, and songbirds to estimate species abundance and diversity, describe habitat associations within the LSA and RSA and to record any listed species. Aerial and ground surveys were conducted for amphibians in order to identify western toad breeding sites within the LSA and RSA. These methodologies and results are discussed in more detail in this section below and in Appendix 13-A.

Habitat suitability models provide a means of identifying the spatial extent and distribution of habitats across the landscape. Wildlife habitat suitability modelling was conducted for seven terrestrial species in the LSA and RSA. Two campaigns of field work were conducted to support the habitat suitability modelling: the first phase occurred in October 2010 which allowed for revisions of the initial wildlife habitat ratings that was developed prior to field work. The second phase was conducted in July 2011 and allowed for revisions of the preliminary wildlife habitat ratings.

Habitat models were developed using species accounts specific to the project area, wildlife habitat suitability ratings tables and a spatial representation of the ratings in a series of habitat suitability maps for each species (detailed in Appendices 13-B and 13-C). Wildlife habitat suitability ratings were guided by following Resources Inventory Standards Committee (RISC) standards which identify areas that provide suitable (i.e., functioning) habitat for a particular species. Wildlife habitat suitability ratings were applied to all ecosystem units within the RSA using Predictive Ecosystem Mapping (PEM) (Section 11).

Mapping of the LSA was performed using British Columbia Terrestrial Ecosystem Mapping (TEM), which provides more precise ecological information relative to PEM. Each species model for the LSA was refined using Bayesian Belief Networks (BBN) as a tool to assign habitat suitability ratings (McNay et al. 2006; Marcot et al. 2006; Wilson and Hamilton 2007). Wildlife habitat suitability modelling for each species is summarized below and detailed in Appendix 13-B and 13-C.

Wildlife inventory and habitat suitability modelling were conducted for specific ungulate species within the LSA and RSA. Aerial surveys were conducted for mountain ungulates (caribou and mountain goats) following established protocols (RISC 2002) within 12 distinct survey units (SUs) in the RSA during 2010 (Appendix 13-A). Survey units were delineated using topographic features that could limit the movement of animals between units and encompassed suitable habitat for mountain ungulates, covering approximately 1,722 km^2 of the RSA. During the winter of 2013, snow track surveys were conducted within the LSA. Ten transects were established prior to surveys.

During both surveys, a GPS waypoint was recorded for each wildlife observation; species, age, and sex (i.e., goats were classified as adults or kids, caribou were classified as bull, cow, or calf) were noted where possible (RISC 2002). For each mountain ungulate observation, the vegetation cover and habitat

suitability rating (HSR) were recorded, based on topographic and vegetative features used for habitat suitability modelling (Appendix 13-A). During the surveys, sightings of other ungulate species were noted and a GPS waypoint was recorded wherever possible. Observations of ungulate species during other wildlife baseline studies were also recorded as incidental observations.

Habitat suitability modelling was conducted for four ungulate species; caribou, moose, mountain goat, and elk. Methods used for each species are outlined below.

13.5.3.1 Caribou

Habitat suitability modelling was conducted for the northern ecotype of woodland caribou, which includes both the Quintette herd. Three categories were rated for the northern ecotype of woodland caribou, hereafter referred to as woodland caribou or caribou: living requisites during the winter (LI-W) and growing (LI-G) seasons, and spring birthing habitats (RB). Living requisites includes both feeding and security requirements; they were grouped together for rating rather than separately as it is more likely that caribou habitat use is based on a favorable combination of features providing both forage and security from predation. Ratings were assigned to ecosystem units within the LSA and RSA based on their relative quality compared to the provincial benchmarks for caribou living in the winter (November to April), and growing season (spring, summer, and fall; May to October), and birthing habitats (spring).

The winter season provincial benchmark for woodland caribou includes two biogeoclimatic (BGC) zones; the lodgepole pine forests associated with the undifferentiated Spruce-Willow-Birch (SWBun) BGC zone and the alpine grassland associated with the Boreal Altai Fescue Alpine (BAFA; formerly classified as Alpine Tundra or AT) BGC zone. These BGC zones are within the Stikine Plateau (STP) ecosection of the Northern Boreal Mountains (NBM) ecoprovince. The growing season provincial benchmark is the alpine meadow associated with the BAFA BGC zone, within the same ecosection and ecoprovince as the winter season benchmarks. These benchmarks represent the best habitat provincially available; thus, were assigned a rating of "1" and used as a comparison against habitats within the study area (MELP 1999). A substantial level of knowledge on the habitat requirements of caribou in the RSA exists, thus a 6-class rating scheme was used for habitat suitability modelling.

13.5.3.2 Moose

Moose habitat was assessed for two categories; living requisites during the winter (LI-W) and growing (LI-G) seasons. The winter season provincial benchmark for moose is the Boreal White Spruce Trembling Aspen (BA/1) broad ecosystem unit of the moist warm subzone of the Boreal White and Black Spruce biogeoclimatic zone (BWBSmw). The growing season provincial benchmark for moose is the White Spruce-Balsam Poplar Riparian (PR/1) broad ecosystem unit of the BWBSmw subzone. Both of these units occur within the Peace Lowland (PEL) ecosection of the Boreal Plains (BOP) ecoprovince. There is a substantial level of knowledge on the habitat requirements of moose in the RSA, thus a 6-class rating scheme was used. The provincial benchmarks for winter and growing seasons were assigned a rating of "1" and are used as a comparison against habitats within the study area (MELP 1999).

13.5.3.3 Mountain Goat

Two life requisite categories were rated for mountain goat in the LSA and RSA: living requisites during the winter season (LI-W) and growing season (LI-G). These ratings are consistent with wildlife habitat ratings methods (MELP 1999).

There is a substantial level of knowledge on the habitat requirements of mountain goat in the RSA, thus a 6-class rating scheme was used for habitat suitability modelling. Provincial benchmarks including both the winter and growing seasons were assigned a rating of "1" and were used as a comparison against habitats within the study area (MELP 1999). The winter season provincial benchmarks for mountain goat are the MF/6-Mountain Hemlock-Amabilis Fir/RO-Rock of the Mountain Hemlock moist maritime subzone (MHmm), and EF/6 – Engelmann Spruce-Subalpine Fir/RO – Rock of the Engelmann Spruce-Subalpine Fir dry cool subzone (ESSFdk) of the Nass Ranges (NAR) and Southern Park Ranges (SPK) ecosections within the Coast and Mountains (COM) and Southern Interior Mountains (SIM) ecoprovinces respectively.

The growing season provincial benchmarks are the alpine meadows associated with BAFA and Coastal Mountain-heather Alpine (CMA) BGC zones of the same ecosections and ecoprovinces as the winter season. Both BAFA and CMA BGC zones were formerly grouped as one BGC zone (Alpine Tundra).

13.5.3.4 Elk

Habitat for Rocky Mountain elk, hereafter referred to as elk, was assessed for the generalized living life requisites for two seasons: winter (LI-W) and growing (LI-G) seasons. These habitat attributes were assessed only within the LSA as modelling did not occur within the RSA.

The winter season provincial benchmark for elk is the Boreal White Spruce-Trembling Aspen (BA/1) broad ecosystem unit of the Spruce-Willow-Birch moist cool (SWBmk) biogeoclimatic ecosystem classification (BEC) subzone. The growing season provincial benchmark is the subalpine meadow associated with the SWBmk subzone. These units are within the Muskwa Foothills (MUF) ecosection of the Northern Boreal Mountains (NMB) ecoprovince. The provincial benchmarks for winter and summer growing seasons were assigned a rating of "1" and are used as a comparison against habitats within the study area (RIC 1999). There is a substantial level of knowledge on the habitat requirements of elk in the RSA, thus a 6-class rating scheme was used for habitat suitability modelling.

13.5.3.5 Grizzly Bear

Four life requisites categories were rated for grizzly bear: winter hibernating (HI), spring living (LI-P), summer living (LI-S), and fall living (LI-F). The life requisites that were rated for grizzly bear reflect the expected seasonal habitat use.

There are no formal provincial benchmarks available for grizzly bear in the interior. However, the Engelmann Spruce-Subalpine Fir dry cool variant (ESSFdk) and Montane Spruce dry cool variant (MSdk) within the Border Ranges (BRR) ecosection have been used previously as benchmarks for interior grizzly bears (Sargent et al. 2010). The BRR lies within the SIM ecoprovince in the East

Kootenay's and includes the Flathead Valley. The benchmark was used for spring and fall rating. There is a substantial level of knowledge on the habitat requirements of grizzly bear in the RSA, thus a 6-class rating scheme was used for habitat suitability modelling.

Incidental observations of bears were recorded during all surveys throughout 2010 to 2013. A GPS waypoint of the observation, number observed, age category, and habitat were noted when possible.

13.5.3.6 Furbearers

In British Columbia furbearers are legally designated species that have traditionally been hunted or trapped for their fur. To provide baseline information on the presence and distribution of furbearers in the LSA, winter snow track surveys were conducted in 2013 (Appendix 13-A). Wildlife tracks were counted along ten transects totaling 19.7 km. Survey effort for furbearers focused on American marten, which is sensitive to human disturbances but is usually abundant enough to derive adequate sample sizes for inferences about habitat associations. Based on American marten habitat selection identified elsewhere (Lofroth 1993), the LSA was stratified into mature and young coniferous, mixed wood, and deciduous forests. Less than 5% of the LSA is covered by deciduous forest, 44% is coniferous forest (20% mature, 24% young), 20% is mixed wood forest (12% mature and 8% young), and 31% is not forested. Tracks of other furbearer species were also recorded when they were observed.

Habitat suitability modelling was conducted for one furbearer species. The fisher is a provincially blue-listed species.

Two life requisite categories were rated for fisher: living during all seasons and birthing habitat. Life requisites such as foraging, thermal cover, and resting habitat characteristics for fisher are inter-related and required year round; thus were covered in the living category (LI-A). Specific habitat features are required for the reproduction period; as such, birthing habitat was considered separately (BI). There is a substantial level of knowledge on the habitat requirements of fisher in the RSA, thus a 6-class rating scheme was used for habitat suitability modelling. There are no formal provincial benchmarks available for fisher.

13.5.3.7 Bats

Eight species of bat potentially occur within the LSA and RSA, (Table 13.5-2). Surveys for bats were conducted during 2010 between dusk and dawn at three survey sites. Bats were surveyed by recording the ultrasonic calls that bats emit for echolocation of their insect prey using a broad band bat detector (Anabat II, Titley Scientific Ltd.) which converts the ultrasonic sounds of bats to sound frequencies that are audible to the human ear. To differentiate between species and genus, the frequency and duration of the recorded calls were compared to available published accounts and voucher sonograms for several species (Fenton and Bell 1981; RIC 1998; Madison et al. 2003; McCaffrey, Rodhouse, and Garrett 2003). Visual representation of each call, or sonograms were recorded and analyzed to genus, and sometime to species using search and approach phase calls. Sample frequency ranges of species likely to occur in the study area are reported in Table 13.5-2. Species were deemed likely to occur in the area based on multiple references (D. W. Nagorsen and Brigham 1995), RTEC (2006, 2008), Finavera 2011; Rescan (unpublished data).

Table 13.5-2. Bat Species Potentially Occurring within the Study Area

Common Name	Scientific Name	Examples of Call Characteristics[1]		
		High Freq. (kHz)	Low Freq. (kHz)	Maximum Duration (ms)
Long-eared myotis	*M. evotis*	>100-97	54-40	1-3
Northern myotis	*M. septentrionalis*	110-80	38-40	1-3
Little brown myotis	*M. lucifugus*	78->60	38-40	2-5
Silver-haired bat	*Lasionycteris noctivagans*	37-30	25-26	3-6
Long-legged myotis	*M. volans*	89	40	10
Big brown bat	*Eptesicus fuscus*	33	28	10
Eastern red bat	*Lasiurus borealis*	45-50	30-35	6-10
Hoary bat	*L. cinereus*	27-30	25-20	6-10

[1] *Fenton and Bell (1981), RIC (1998), O'Farrell, Miller, and Gannon (1999).*

13.5.3.8 Raptors

In 2010, stand watch surveys were conducted over a three day period focusing on the LSA (Appendix 13-A). Survey sites were selected based on their potential to support suitable nesting habitat. Site selection was limited by safe vehicle access and by vantage points that provided clear views of raptor activity within available habitat (e.g., tree-tops, cliffs). All survey sites were geo-referenced. For cliff-nesting raptors, surveyors scanned cliffs with binoculars and high-powered spotting scopes for white-wash and/or the presence of *Xanthoria* spp., an orange lichen that is often abundant near nest or roost sites where bird droppings accumulate. For tree nesting raptors, tree-tops were monitored for perching activity and dense spots in the canopy, which could indicate a nest. Habitats were scanned for bird activity for 30 minutes to 1 hour, depending on visibility (influenced by weather conditions). If no bird activity was detected in an area within 30 minutes, the stand watch was stopped and observers moved to the next survey site.

Observations of raptors and raptor nests were also noted and geo-referenced when they were detected incidentally during other wildlife field surveys. Using GIS mapping of Biogeoclimatic Ecosystem Classification (BEC) zones, raptor locations were summed per BEC zone.

13.5.3.9 Songbirds

Bird species that breed in upland areas are referred to as songbirds (i.e., passerines, hummingbirds, swifts, and including woodpeckers, ptarmigan and grouse). Variable radius point count (VRPC) surveys were conducted for songbirds in 2010 following established methods (RIC 1999b). Surveys were conducted between sunrise (~4:30 a.m.), when birds are most active and sing most frequently, and continued until 10 am when bird activity declines. Five point count stations, spaced at least 200 m apart were conducted along each of 20 predetermined transects, each 800 m long. Surveys were not conducted when wind speeds exceeded approximately 30 km/h (5 on the Beaufort scale) or during rain or snow storms.

After a one to two minute settling time upon arrival at each point count station, observers recorded all birds seen and heard within 100 m for a survey period of five minutes. All bird observations were assigned to a 25 m radius interval (i.e., 0 to 25 m, 25 to 50 m, 50 to 75 m, and 75 to 100 m). Birds flying over the point count station and not landing and birds detected beyond 100 m were recorded as incidental detections but were not included in further analyses. Observers recorded species and the number of individuals. Observations of breeding behaviour, habitat descriptions, and weather were also recorded. Evidence of breeding activity included observations of nests, nest material carries, food carries, faecal sac carries, distraction displays, pair bonding, and copulation. Incidental observations of songbird species that were observed during travel between survey sites and those made during other wildlife field inventories were also recorded and geo-referenced.

The relative abundance of individual species was estimated as the total number of birds detected per species along each transect. Species richness was estimated for each transect as the total number of species observed across all point counts. The Shannon-Weiner index of diversity (*H*), a mathematical measure of species diversity in a community was calculated using the equation:

$$H = -\sum_{i=1}^{s} p_i \ln p_i \qquad Or \qquad H' = -\sum_{i=1}^{s} \frac{n_i}{N} \ln \frac{n_i}{N}$$

where ***S*** is the total number of species in a community (species richness) and p_i is the relative abundance of each species, calculated as the proportion of individuals of a given species (n_i) to the total number of individuals in the community (N). Shannon's equitability (E_H), defined as the degree to which species are equally abundant (Reitz and Wing 1999), was calculated by dividing H by H_{max} ($H_{max} = \ln S$) using the following:

$$E_H = \frac{H'}{H_{\max}} = \frac{H'}{\ln S}$$

To identify habitats that support a diverse bird community, average species diversity and equitability was compared among habitat types. Five general habitat categories were identified within the Murray River area: coniferous forest, deciduous forest, mixed coniferous/deciduous forest, riparian/wetland habitat, and disturbed habitat (Appendix 13-A). To compare these metrics among habitat types, the data were analysed using mixed-effects linear models with a normal error distribution. Transect location was entered as a random effect in the model and habitat type was entered as a fixed effect. This allowed comparing the metrics across habitat types while considering the spatial proximity of point count locations along the same transect. Statistical effects of habitat type on each metric were assessed with F tests.

Habitat suitability modelling was also conducted on the black-throated green warbler.

Black-throated Green Warbler

The life requisite for reproducing (RE) was assessed for black-throated green warbler as it incorporates a number of habitat requirements including those for feeding, nesting, and security

during the breeding season (i.e. spring/early summer). As there is an intermediate level of knowledge on the breeding habitat requirements of Black-throated green warbler in the RSA, a 4-class rating system was used. There are no formal provincial benchmarks available for black-throated green warbler.

13.5.3.10 Waterbirds

Waterbirds include dabbling ducks, diving ducks and seabirds, loons, mergansers, geese, swans, shorebirds, and any water-dependent bird species, such as the belted kingfisher and sora. In this report, the term "waterbird" is used as an umbrella term to encompass duck and geese species.

To document the presence and distribution of waterbirds in the LSA and RSA, both aerial and ground surveys were conducted during each of the survey periods; breeding (spring/summer) 2010, fall staging 2011, and spring staging 2012. Aerial surveys were conducted over waterbodies that were inaccessible by foot, and included the extents of Murray River, Wolverine River, Flatbed Creek, large waterbodies such as Bearhole Lake and Quality Lake, and wetlands within the RSA. Aerial surveys were conducted by helicopter flying at speeds of 40 to 100 km/hour depending on weather conditions, and at a height of approximately 30 to 50 m above the water (RIC 1999c). A navigator and one observer recorded all bird observations. A handheld Garmin GPS was used to record the approximate UTM coordinates where birds were detected.

Ground surveys of wetlands were conducted using binoculars and spotting scopes for a maximum duration of 20 minutes and within a 200 m observation radius. During ground surveys, the species, number of individuals, gender (if possible), and behaviour were recorded. When broods were observed, the number of young and brood class were also noted (Appendix 13-A).

For both aerial and ground surveys, wetlands were geo-referenced and assigned a wetland type and size. Wetland type was classified into seven categories: creek, river, marsh, swamp, pond, lake, and artificial. Wetlands that were not classified were labelled as unclassified. Streams with an ephemeral or seasonal hydroperiod were classified as creeks; streams and rivers with semi-permanent or permanent hydroperiod were classified as rivers. Marsh habitat was classified on the basis of open water and ≥ 25% grass, sedges, and associated vegetation. Swamps were comprised of open water and ≥ 25% shrubs. Ponds were identified as naturally occurring waterbodies with organic substrate and substantial emergent vegetation. Lakes were distinguished from ponds as deeper natural-occurring waterbodies with predominantly non-organic substrate. Artificial waterbodies, which ranged in depth, were evident from their regular shape, location, and relatively small size. Habitat size was classified as small, medium, and large. Small wetlands were ≤0.5 hectares (ha), medium wetlands were > 0.5 to < 2 ha, and large wetlands were ≥ 2 ha in area.

13.5.3.11 Amphibian

An aerial reconnaissance survey was conducted in 2010 to identify potential western toad breeding sites within the LSA and RSA. A subset of wetlands and ponds identified during the aerial reconnaissance survey were subsequently surveyed from the ground. Where ground access permitted, survey locations were prioritized to those with high and moderate habitat ratings as assigned during the aerial survey.

Breeding western toads require open water deep enough to prevent drying out prior to tadpole metamorphosis, but with sufficient shallow areas (<0.5 m) to support egg-laying. Breeding is supported in wetland areas that have limited tree canopy, relatively shallow water, and a low level of water flow (Pyare 2005).

Field methods for the detection of amphibian species were adapted from standard amphibian sampling techniques and western toad monitoring programs (Crump and Scott 1994; Leonard, Bury, and Olson 1997; Pyare 2005). Survey timing reflected the period when western toad breeding is easiest to observe, as toadlets often aggregate along margins of waterbodies during the late summer. Observers searched shorelines, waterbodies, and terrestrial habitat adjacent to the pond margin using the Visual Encounter Survey (VES) technique and net sweeps to locate evidence of breeding, such as the presence of tadpoles and emerging toadlets.

Amphibians were identified and classified into two broad life stages: juvenile (tadpole/larvae, metamorph/toadlet, or yearling) or adult (>2 years of age). Photographs were taken whenever possible. Amphibians were handled using powder-free latex gloves, and standard protocols were followed to sterilize field gear to minimize the transference of pathogens (i.e., chytrid fungus) and toxins (i.e., insect repellent, hand moisturizers). Observers also measured several biotic and abiotic environmental and habitat characteristics at each site where amphibians were observed (Appendix 13-A).

Wetlands were geo-referenced and assigned a wetland type and size during both aerial and ground surveys. Wetland type was classified into four categories: marsh, swamp, pond, and lake. Wetlands that were not classified were labelled as unclassified. Some wetlands were comprised of more than one wetland type, and so were classified as a "wetland complex". Habitat size was classified as small (≤0.5 ha), medium (>0.5 to <2 ha), and large (<2 ha). Each site was also rated for overall toad habitat quality as high, moderate, or poor.

13.5.4 Wildlife and Wildlife Habitat Baseline Conditions

Baseline conditions for twelve wildlife species or groups were evaluated using a combination of habitat suitability modelling and field surveys. These wildlife species are found in three groups: mammals, birds, and amphibians:

- Mammals:
  - Caribou
  - Moose
  - Mountain goat
  - Elk
  - Deer (mule and white-tailed)
  - Grizzly bear
  - Furbearers (Fisher)
  - Bats

- Birds
  - Raptors
  - Songbirds
  - Waterbirds
- Amphibians
  - Western toad

The following sections provide an overview of the results of habitat suitability modelling and baseline studies. Methods for the habitat suitability modelling are reviewed in Section 13.5.3. More information on each species in the RSA and LSA is available in the wildlife baseline reports (Appendix 13-A) and habitat suitability reports (Appendices 13-B and 13-C).

13.5.4.1 Baseline Surveys for Ungulates

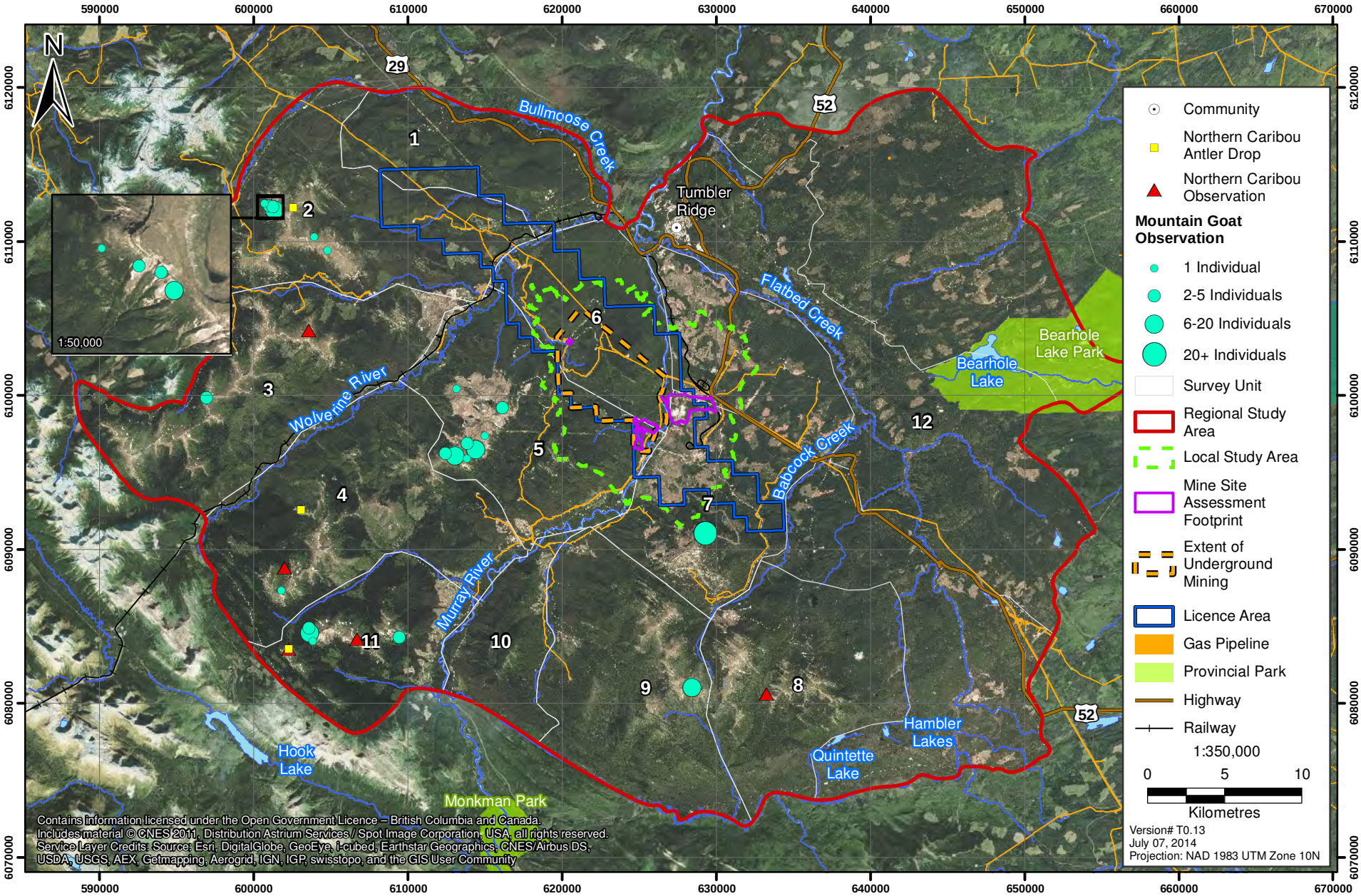
Northeastern BC is home to a number of ungulate species; the species with the highest probabilities of occurring year round in the RSA are caribou, elk, mountain goat, mule deer, and white-tailed deer. The southern mountain population of woodland caribou, which are expected to occur in the RSA, are provincially red-listed and are listed as Threatened by the SARA (Schedule 1).

Surveys for ungulate species occurred in 2010 and 2013. Summer aerial surveys that targeted mountain ungulates (woodland caribou and mountain goat) were conducted on July 19 and 20, 2010; all SUs were surveyed with the exception of SU 6 as it lacked suitable terrain. This SU was surveyed from the ground on July 20, 2010. Surveys were thorough in above treeline habitat, where mountain goat and caribou are expected to occur in the summer. All ungulate species expected to occur within the RSA were observed during baseline surveys in 2010: woodland caribou, mule deer, white-tailed deer, elk, mountain goat, and moose. During aerial surveys, five individual caribou were observed within four SUs outside of the LSA (four males and one female; Figure 13.5-2; Appendix 13-A). Caribou calves were not observed. In addition, there were observations of shed caribou antlers in alpine areas within SUs 2, 4, and 11 (Figure 13.5-2). The small sample size precluded a spatial analysis of caribou observations. However, based on collar information on Quintette caribou, this herd is predominately located in fir forests, parkland areas, and the alpine during summer. Habitat use is generally limited to areas above 1,300 m.

A total of 138 mountain goats in 22 groups within 7 SUs were recorded during aerial surveys, all of which were observed outside of the LSA (Figure 13.5-2; Appendix 13-A). The majority of mountain goats (90 individuals) were observed in SU 5 (32%) and SU 7 (33%); these SUs include previous mining projects (Wolverine and Quintette Mines). Adults accounted for 83% of all goats observed; the overall ratio of kids to adults was 21 kids per 100 adults. The group size of mountain goats ranged from 1 to 46 individuals, averaging 6.3 ± 2.1 individuals (± standard error). Most observations (65%) consisted of more than one individual.

Figure 13.5-2

Mountain Goat and Northern Caribou Observations during Aerial Surveys, 2010



Mountain goats were observed on a range of aspects; the average elevation of goat groups was 1,691 ± 37 m (90% ranged between 1,497 and 1,890 m; Appendix 13-A). The majority of observations (90%) were generally on slopes between 14° and 44° (mean 28° ± 3°). Nine groups were observed on warmer south facing slopes, nine groups were detected on cooler northerly slopes, and four groups were observed on slopes with a neutral thermal advantage (e.g., east or west facing slopes; Appendix 13-A).

A total of 14 elk, 10 moose, 8 white-tailed deer, 3 mule deer, and 4 unknown deer were incidentally observed in 2010 (Figure 13.5-3; Appendix 13-A). Elk were observed on five separate occasions, including two groups of five or more individuals. Moose were observed on six separate occasions. In July, two moose were observed with young; one cow with a calf and another with twins. Of the deer species, more white-tailed deer were recorded than mule deer, and four deer could not be identified to species. Most incidental observations were recorded outside of the LSA; only one Rocky Mountain elk, two mule deer, and one white-tailed deer were recorded within the LSA (Figure 13.5-3).

Ungulate sign was also recorded during baseline studies conducted in 2010, including winter browse activity, pellets belonging to multiple species, and a mineral lick/wallow (Figure 13.5-3; Appendix 13-A). Winter browse and pellets belonging to moose were recorded downstream along Murray River and along the Wolverine River. Heavy browse on riparian vegetation was observed along Murray River near the Mine Site Assessment Footprint, as well as winter pellets belonging to moose and deer, and possibly Rocky Mountain elk and caribou. In addition, a mineral lick/wallow with evidence of recent use was detected in the same area on the west side of Murray River. To augment aerial surveys conducted during summer, data on the presence of ungulates within the LSA during winter were collected using snow track surveys conducted on March 19 and 24, 2013 (Appendix 13-A). Wildlife tracks were surveyed along ten transects totaling 19.7 km. Based on deer preference for low elevation and warmer sites during winter, the LSA was stratified into two zones (above and below 1,000 m), and three aspect ratios corresponding to their temperature gradients – cold, neutral, and warm. The majority of the LSA consists of neutral aspect sites - 40% low elevation and 20% higher elevation. Lower elevation, warm sites cover 20% of the LSA. Approximately one third of the sampling effort was spent along higher elevation transects (5.9 of 19.7 km). During surveys, deer tracks were observed only at lower elevation sites (< 1,000 m) and the majority of these (92%) were observed on warmer aspects. Moose tracks were observed across all aspect categories at lower elevation sites and at neutral sites above 1,000 m. However, moose tracks were not observed in coniferous forests. Caribou, elk, and mountain goat tracks were not detected.

13.5.4.2 Caribou

There are three ecotypes of woodland caribou in British Columbia (BC); boreal, mountain, and northern. Behaviour of caribou within each ecotype differs. The Project is located in the range of the Quintette herd of the northern ecotype of woodland caribou (Jones et al. 2004; Jones 2009). This herd is part of the central mountain population of woodland caribou. This population of caribou occupy the east side of the Rocky Mountains, south of Peace River, BC and includes Banff National Park, Alberta. The central mountain population are considered Endangered by COSEWIC (BC CDC 2013).

They are also an Identified Wildlife Element under the Government of BC IWMS, and therefore require special conservation measures within the province (BC MWLAP 2004a, 2004e). Prior to May 2013, these two caribou herds were included in the southern mountain population and the central population designation did not exist. Therefore, the central population does not yet have a SARA status. The southern mountain population of caribou was, and is, included in Schedule 1 of SARA, is provincially red-listed, and is provincially designated as "Identified Wildlife" under the Identified Wildlife Management Strategy (BC CDC 2013). The new grouping of the southern mountain designatable unit is also ranked as Endangered by COSEWIC (BC CDC 2013). Herein, the northern ecotype of woodland caribou will be referred to as woodland caribou or caribou.

Eight WHAs for caribou exist within or bordering the RSA (WHA 9-059 to 9-066). Ungulate winter range #U-9-002 designated for caribou and mountain goats includes units SPC-009, 014, 015, 016, 017, 046, and 047, all located within the RSA. A portion of UWR #U-9-002, SPC-047 is located above the 1300 m contour in the southwest corner of the LSA. However, none of the WHAs or UWRs lie within the proposed project footprint as identified in current mine planning.

Caribou habitat requirements for forage and security vary between season and life stages. Habitat selection by caribou in all seasons is a balance between the availability, abundance, and quality of forage and the risk of predation (Jones 2007). The following general seasonal habitat requirements are expected for woodland caribou.

Winter Season Living Requisites

Different ecotypes and herds within ecotypes make use of different areas and exhibit differing winter migration patterns in response to predation risk, snow depths, and snow density.

Living habitat requirements during the winter season for the Quintette herd caribou are typically associated with the following habitat attributes:

- Alpine and ridges where terrestrial lichens are exposed;
- Windswept alpine ridges > 1,500 m; and
- Forage consisting primarily of terrestrial lichen, but arboreal lichen and dwarf shrubs may also be used.

The majority (89.6%) of winter living habitat for Quintette herd caribou within the LSA has a habitat suitability rating of Very Low (77.5%) and Low (12.1%) Table 13.5-3 and Figure 13.5-4). Suitable winter living habitat amounts to just over 10%; 5.5% Moderate, 3.7% Moderately High, and 1.0% High rated habitat (Table 13.5-3). This habitat is located primarily in small pockets along the western and northwest side of the LSA with a small amount located in the south end of the LSA (Figure 13.5-4). The majority of suitable winter living habitat is located outside of proposed areas of development with the exception of the extent of underground mining.

Figure 13.5-3
Incidental Observation of Ungulates and Ungulate Sign during Baseline Studies, 2010

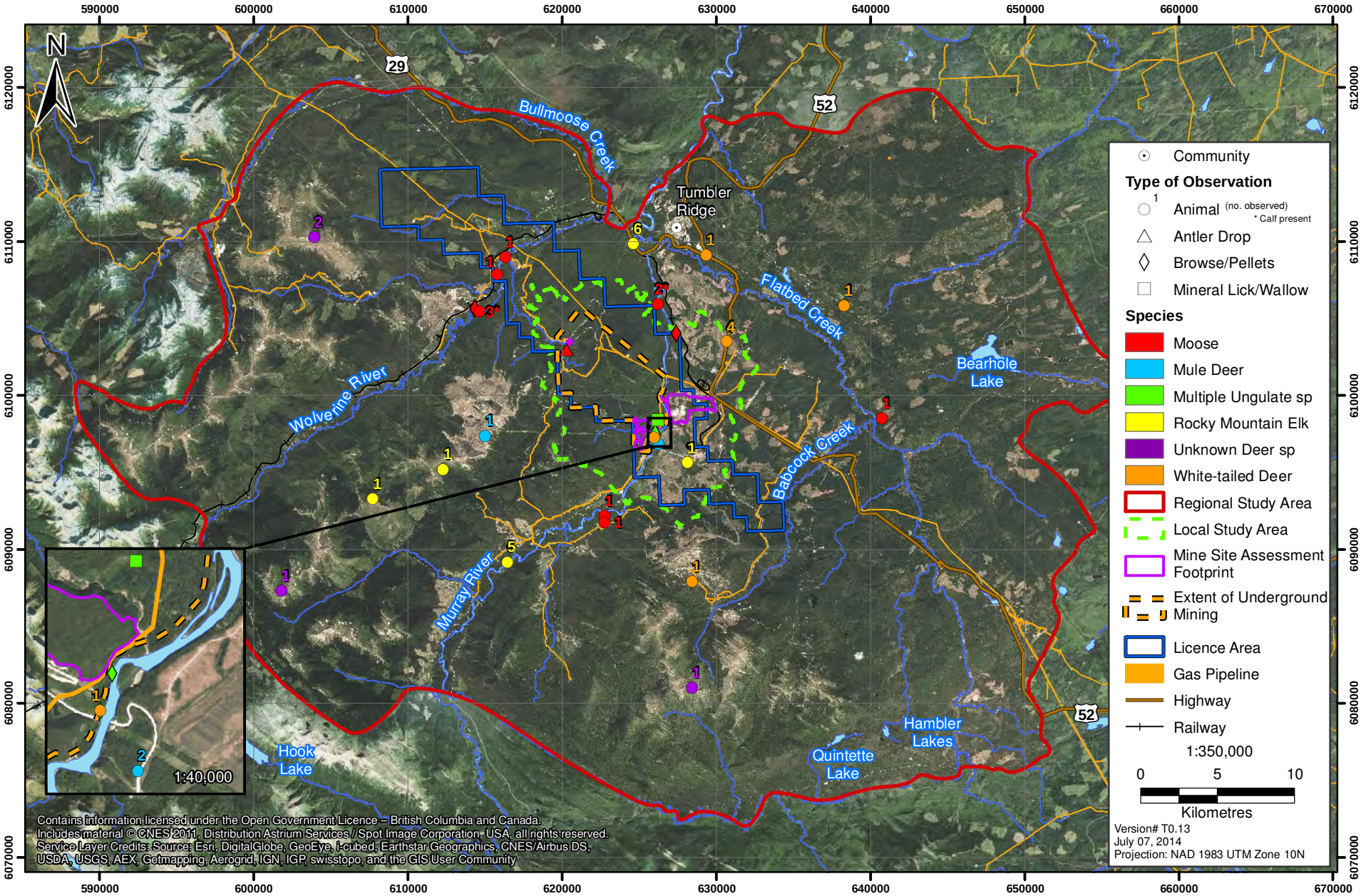


Figure 13.5-4

Quintette Caribou: Winter Living Habitat in the Local Study Area

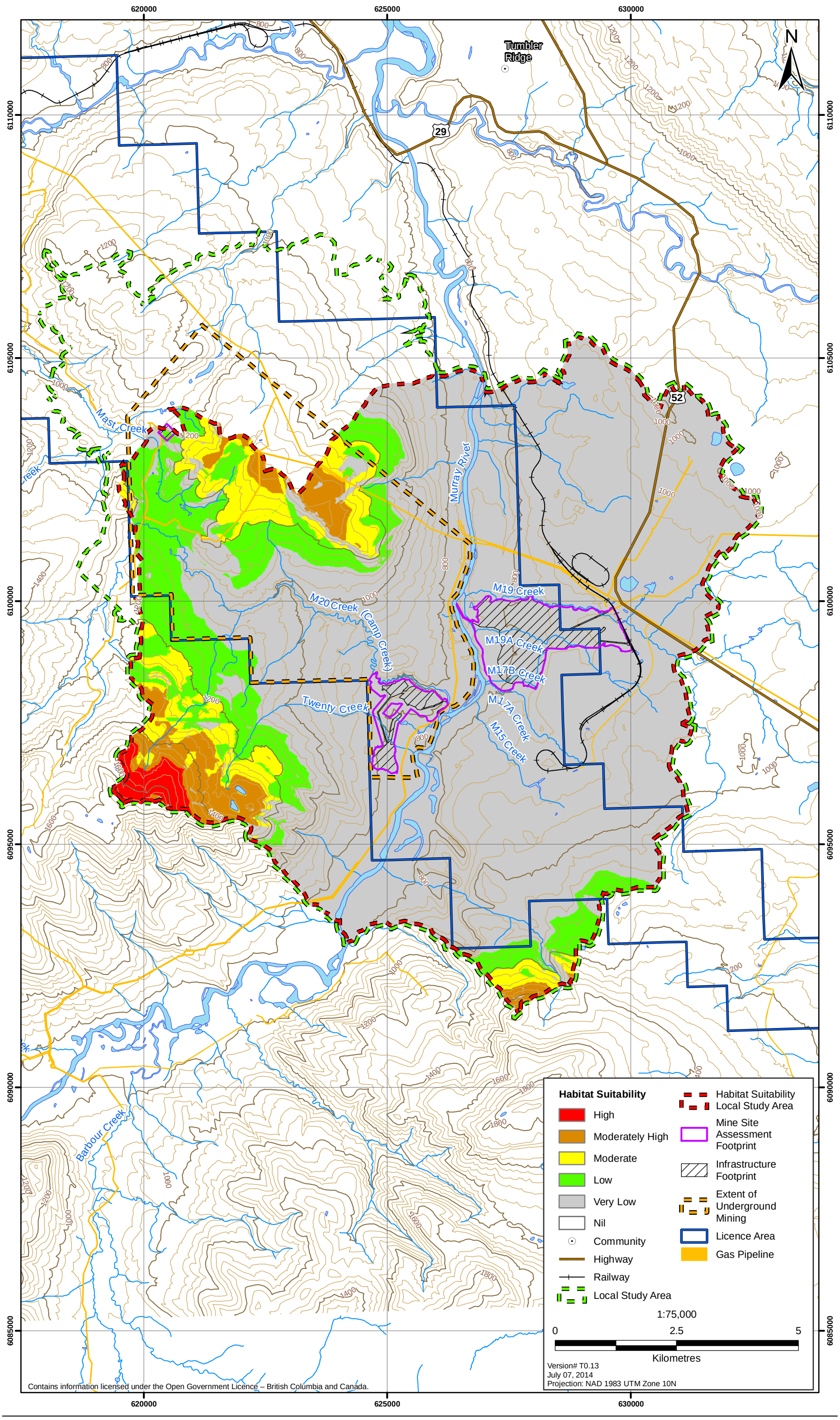


Table 13.5-3. Area and Proportion of Habitat within the Local Study Area and Regional Study Area for Woodland Caribou

Suitability Ratings	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
	Area (ha)[1]	% of LSA[2]	Area (ha)[1, 3]	% of RSA[2]
Winter Living				
High	120	1	490	0
Moderately High	449	3	2,102	0
Moderate	662	5	8,975	3
Low	1,468	12	89,373	39
Very Low	9,373	77	124,455	54
Nil	0	0	2,179	1
Unclassified	17	0	39	0
Growing Living				
High	120	1	490	0
Moderately High	551	4	4,655	2
Moderate	1,319	10	17,413	7
Low	709	5	74,823	32
Very Low	9,373	77	128,014	56
Nil	0	0	2,179	1
Unclassified	17	0	39	0
Calving				
High	NA	NA	6,494	2
Moderately High	NA	NA	12,101	5
Moderate	NA	NA	1,835	0
Low	NA	NA	7	0
Very Low	NA	NA	0	0
Nil	NA	NA	207,137	91
Unclassified	NA	NA	39	0

[1] LSA = 12,092 ha, RSA = 227,615.8 ha, and NA = Not Assessed.
[2] For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100% (e.g., 99% or 101%).
[3] Includes area of LSA.

Within the RSA, the majority (95%) of winter living habitat for Quintette herd caribou is rated as non-suitable; Low (39.3%), Very Low (54.7%), or Nil (1.0%; Table 13.5-3). A small amount (5%) of suitable winter living habitat exists in the RSA (3.9% Moderate, 0.9% Moderately High, and 0.2% High rated habitat) and is primarily located along high elevation areas on the western side of the RSA with a small amount located within the southern portion of the RSA (Table 13.5-3 and Figure 13.5-5). Suitable winter living habitat overlaps with the UWR in the western portion of the RSA (west of Highway 52). It also overlaps with the designated WHAs in the RSA.

Growing Season Living Requisites

Living habitat requirements during the growing season (spring, summer, and fall) for the Quintette herd caribou are typically associated with the following habitat attributes:

- Alpine tundra and parkland that provide abundant terrestrial lichens;
- Subalpine, fir-leading, high elevation forests used, but to a lesser degree; and
- Forage species including terrestrial lichen, willow, birch, other shrubs, Labrador tea, *Vaccinium spp*.

Similar to the living habitat during the winter season, the majority (83.4%) of living habitat during the growing season for Quintette herd caribou within the LSA was rated as non-suitable habitat; Very Low (77.5%) and Low (5.9%; Table 13.5-3 and Figure 13.5-6). Suitable growing living habitat accounted for less than 20% of the LSA; 10.9% Moderate, 4.6% Moderately High, and 1.0% High rated habitat (Table 13.5-3). This suitable habitat is located primarily in small pockets along the western and northwest side of the LSA with a small amount located in the south end of the LSA (Figure 13.5-6). The majority of suitable growing living habitat for Quintette caribou is located outside of proposed areas of development with the exception of some Moderate and Moderately High habitat within the extent of underground mining.

As with the LSA, the majority, of the RSA (90.1%) is classified as Low (32.9%), Very Low (56.2%) or Nil (1.0%) rated growing living habitat for Quintette herd caribou. A small amount of suitable living habitat during the growing season (9.9%) is modelled within the RSA; 7.7% Moderate, 2.0% Moderately High, and 0.2% High rated habitat (Table 13.5-3). These habitats are located in high elevation areas primarily on the western side of the RSA with some located in the southern portion of the RSA (Figure 13.5-7).

Calving Requisites

Calving habitat requirements for the Quintette herd caribou are typically associated with the following habitat attributes:

- Subalpine krummholz, parkland, and alpine tundra;
- Alpine and parkland cirques that provide security from the elements; and
- Alpine meadows with clear, open lines of sight.

A small amount of the RSA (9%) is classified as suitable habitat for calving for the Quintette herd; 5.3% Moderately High, 2.9% High, and 0.8% Moderate rated habitat (Table 13.5-3, Figure 13.5-8). The majority of suitable habitat is located in high elevation areas primarily on the western side of the RSA with some areas in the southern portion of the RSA. These areas generally overlap with WHAs within the RSA as well. The remainder, and majority, of the RSA (91%) is classified as Nil rated calving habitat.

13.5.4.3 Moose

Moose occur throughout BC's forested areas with an estimated population size of 145,000 to 235,000 animals (BC MFLNRO 2013). Moose are economically and socially important as a species for harvest by Aboriginal and non-Aboriginal hunters. The Murray River RSA occurs within one of the areas of highest moose abundance in the province (R.V. Rea and Child 2007) and is located within WMU 7-21 of the Peace Region. An estimated 40,000 to 80,000 moose occur in this Region (R.V. Rea and Child 2007), and in WMU 7-21, the total population was last estimated at 2,044 moose with a density of 0.30 moose/km^2 (Rowe 2006).

Figure 13.5-5
Quintette Caribou: Winter Living Habitat in the Regional Study Area

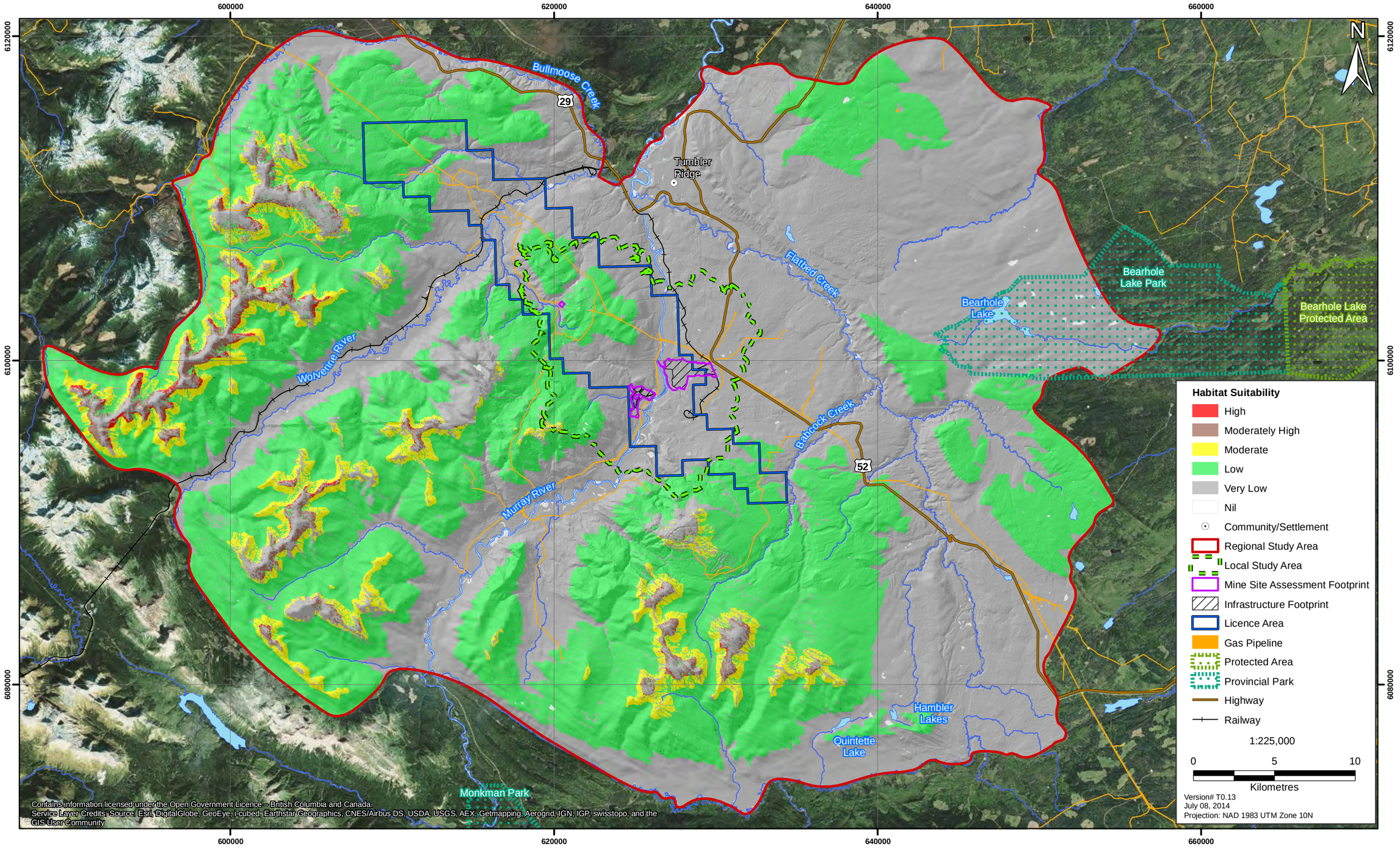


Figure 13.5-6

Quintette Caribou: Growing Living Habitat in the Local Study Area

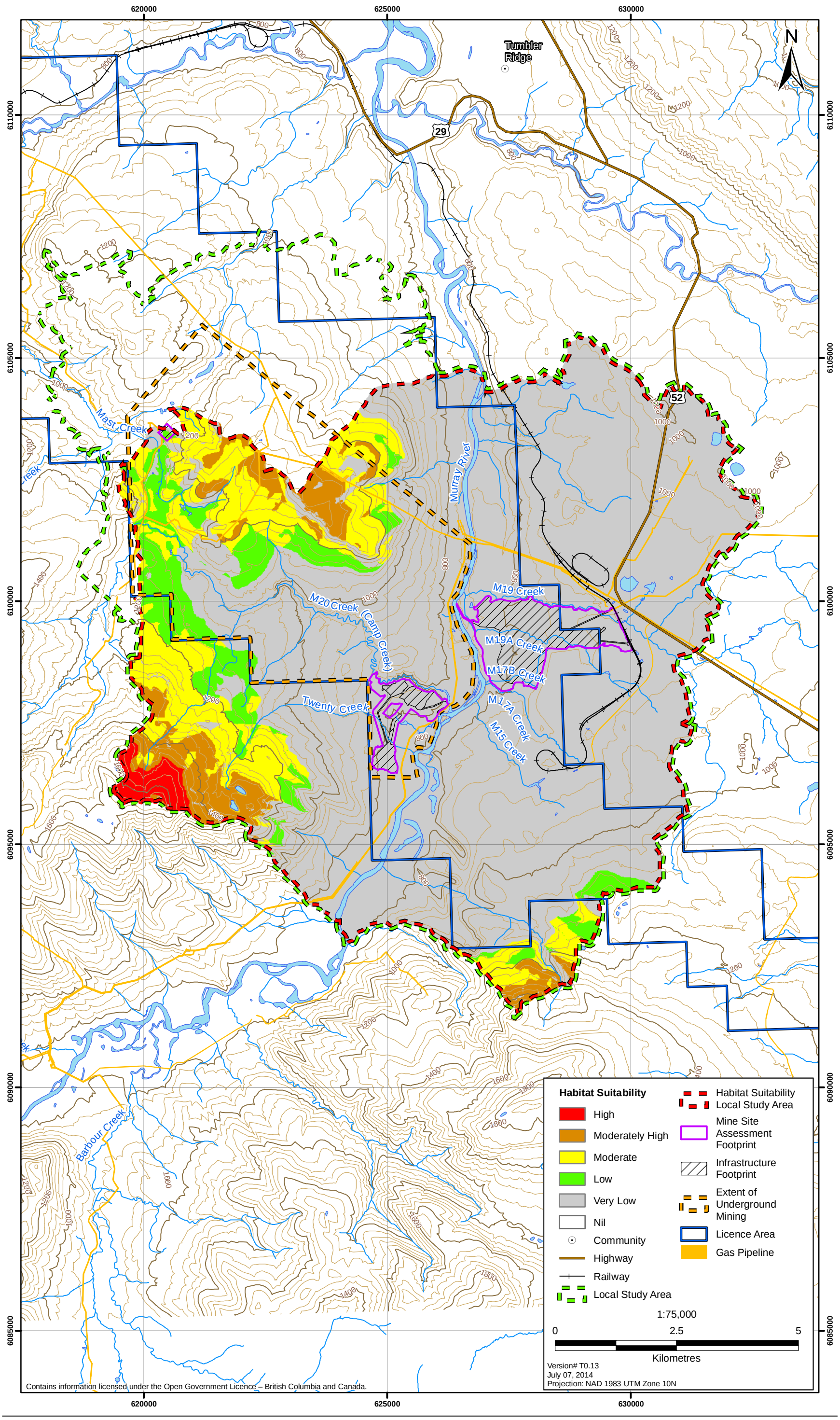


Figure 13.5-7
Quintette Caribou: Growing Living Habitat in the Regional Study Area

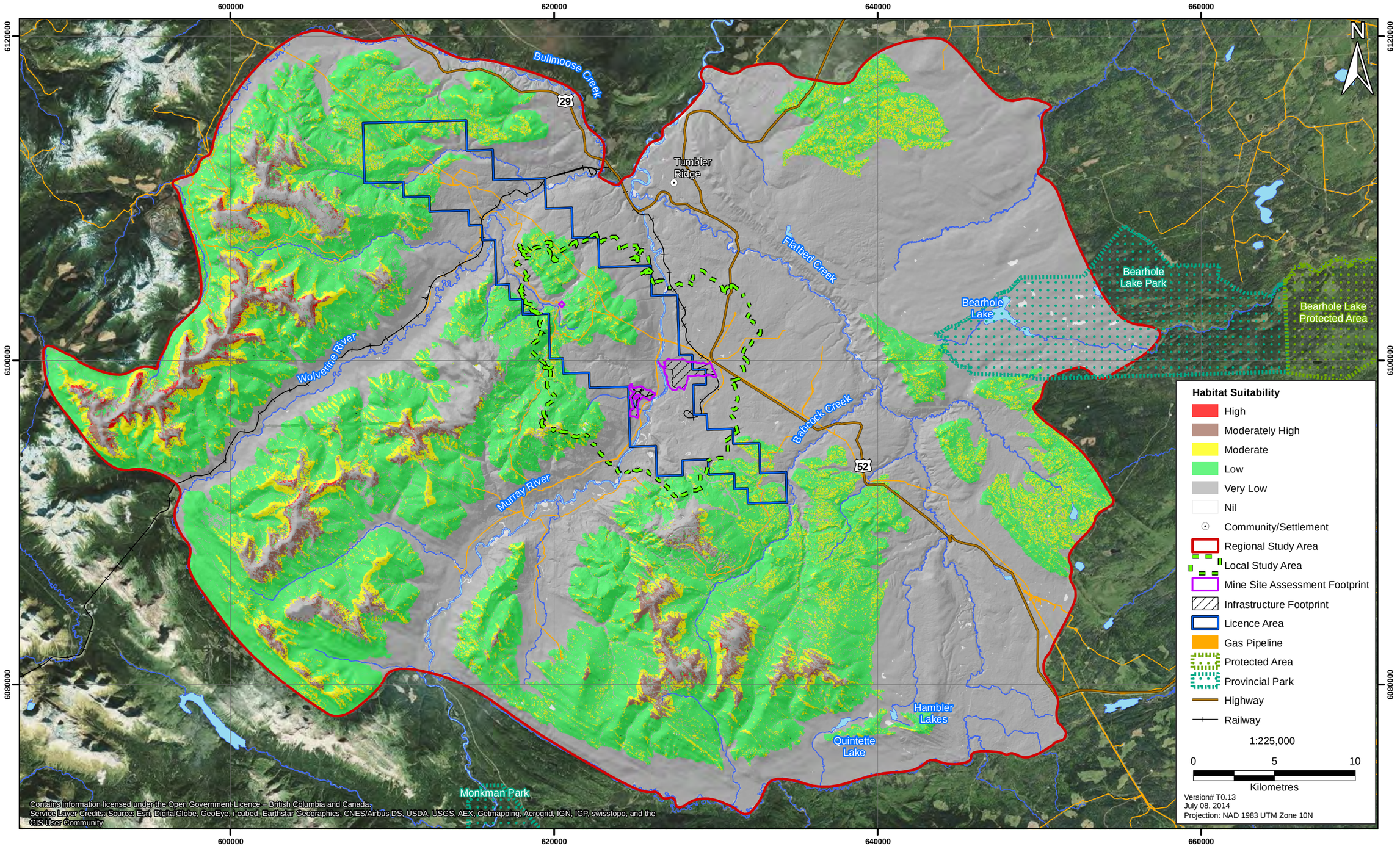
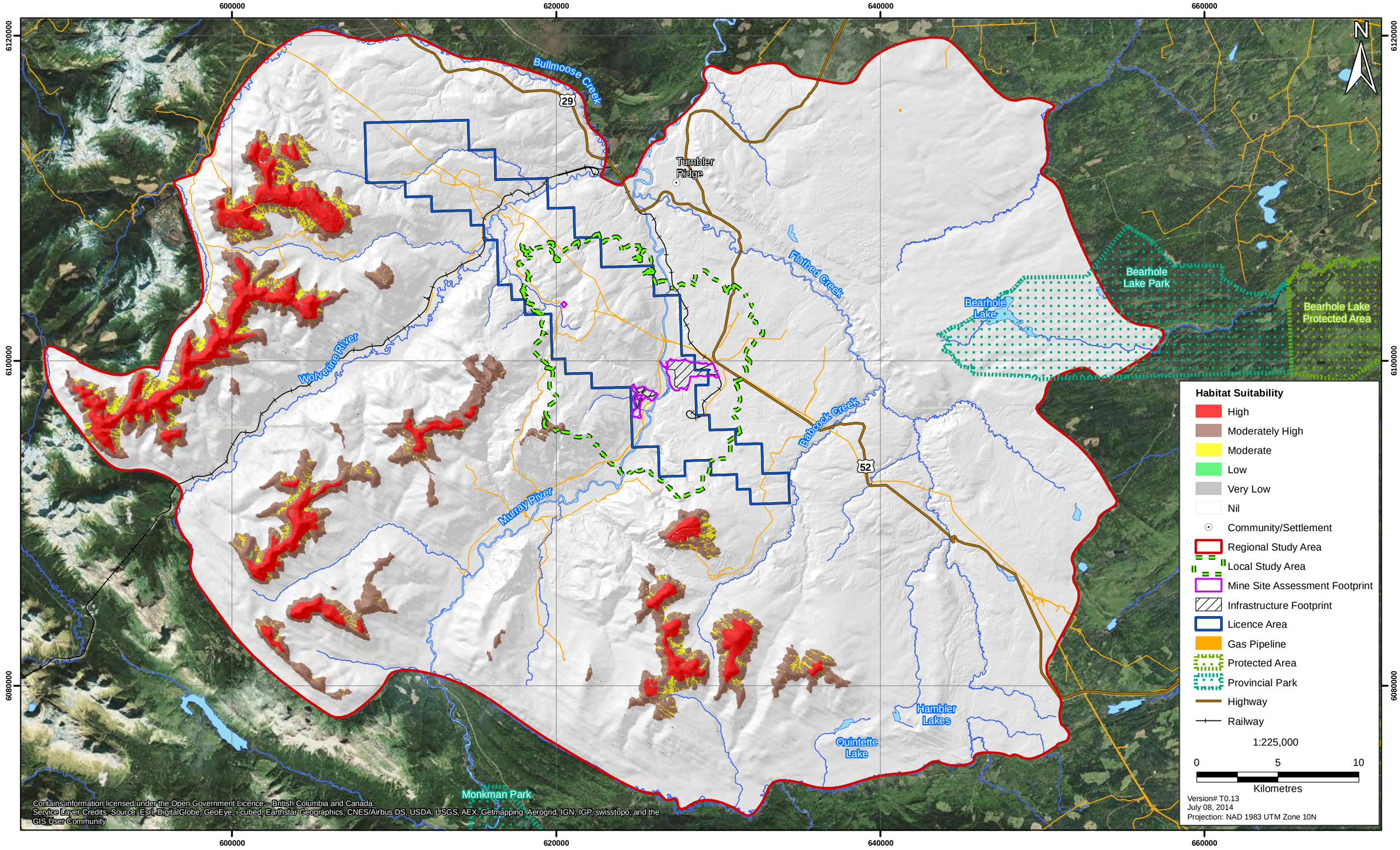


Figure 13.5-8
Quintette Caribou: Calving Habitat in the Regional Study Area



Moose are not a federally listed species, are globally assessed as widespread, abundant, and secure, and are provincially yellow-listed (B.C. Conservation Data Centre 2011). There are no designated ungulate winter ranges (UWR) for moose within the RSA, although, there is one UWR (U-9-001, SPE-023) for elk, mule deer and moose near the RSA north of Bullmoose Creek.

Habitat selection by moose in all seasons is a balance between the presence of suitable forage with cover and other influences such as predation, human activities and snow cover (R.V. Rea and Child 2007). The living requisite for moose primarily depends on both security requirements and forage. Winter habitat is generally the limiting factor in the carrying capacity for moose in BC because of increased energy demands from moving through snow pack and reduced nutritional quality of forage (Safford 2004). The following general seasonal habitat requirements are expected for moose in the RSA.

Winter Season Living Requisites

Most ideal habitat for moose in the winter living habitat include both forage and shelter within close proximity of each other. Winter living habitat requirements for moose are typically associated with the following habitat attributes:

- Low elevation valley bottom and low to mid elevation forest stands in an early to mid seral stage and riparian and alluvial areas, burns, cutblocks, and wetlands;
- Elevations predominantly below 1200 m with limited use between 1000 – 1500 m;
- Gentle slopes;
- Exposed southerly aspects;
- Snow depths less than 70 cm;
- Primarily SBS and BWBS biogeoclimatic zones; and
- Tree and shrub leaves and shoots, deciduous and coniferous leaves and twigs for forage including willow, red-osier dogwood, balsam poplar/black cottonwood, paper birch, trembling aspen, Saskatoon, highbush-cranberry, false box, subalpine fir.

Moose had the highest percentage of suitable habitat present within the LSA, compared to other ungulates. However, the majority (61.3% of the LSA) of winter living habitat for moose within the LSA has a habitat suitability rating of Low (33.4%) or Very Low (27.9%; Table 13.5-4 and Figure 13.5-9). Suitable winter living habitat for moose consisting of High (6.4%), Moderately High (24.5%), and Moderate (7.5%) rated habitat amounts to just under 40 percent (38.4%; Table 13.5-4). This suitable habitat is located primarily along the Murray River corridor and on the northeast side of the LSA with a small amount located in the western side of the LSA (Figure 13.5-9). Suitable winter living habitat occurs within both the eastern and Shaft and Decline Sites as well as a small amount located within the extent of underground mining. The Coal Processing Site includes High rated habitat, which was also modelled between Murray River and the Shaft and Decline Site.

Similar to goat and Quintette caribou herd, the majority of the RSA (80.7%) is classified as non-suitable living habitat during the winter season; 12.0% Low, 51.6% Very Low, and 17.1% Nil rated winter living habitat for moose (Table 13.5-4). Approximately one fifth of the RSA is classified

as suitable winter living habitat for moose; 10.9% Moderate, 5.5% Moderately High, and 2.9% High rated habitat (Table 13.5-4). Suitable High rated winter living habitat for moose is located primarily on the eastern side of the RSA in lower elevation areas with some Moderate and Moderately High rated habitat along the lower elevations of the Wolverine and Murray Rivers (Figure 13.5-10).

Table 13.5-4. Area and Proportion of Habitat within the Local Study Area and Regional Study Area for Moose

	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
Suitability Rating	Area (ha)[1]	% of LSA[2]	Area (ha)[1, 3]	% of RSA[2]
Winter Living				
High	778	6	6,706	2
Moderately High	2,968	24	12,521	5
Moderate	907	7	24,762	10
Low	4,042	33	27,297	12
Very Low	3,376	27	117,339	51
Nil	0	0	38,949	17
Unclassified	19	0	39	0
Growing Living				
High	1,535	12	6,706	2
Moderately High	2,260	18	13,660	6
Moderate	1,459	12	46,399	20
Low	4,237	35	82,970	36
Very Low	2,580	21	60,404	26
Nil	0	0	17,436	7
Unclassified	19	0	39	0

[1] LSA = 12,092 ha and RSA = 227,615.8 ha.

[2] For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100% (e.g., 99% or 101%).

[3] Includes area of LSA.

Growing Season Living Requisites

Moose are less limited during the growing season and their habitat covers a broader area. Habitat requirements for moose during the growing season are typically associated with the following habitat attributes:

- Low elevation valley bottom and low to mid elevation forest stands in an early to mid-seral stage and riparian and alluvial areas, burns, cutblocks, and wetlands;
- Increased use of high elevations (i.e. ESSF, BAFA) compared to winter but also remain in valley bottom floodplains year-round;
- SBS and BWBS habitats used extensively; and
- Tree and shrub leaves and shoots, deciduous and coniferous leaves and twigs for forage including leaves of shrubs and herbs and aquatic and wetland vegetation (e.g. horsetail, sedges, bur weed, submerged pondweed, water lily, and water arum).

Figure 13.5-9

Moose: Winter Living Habitat in the Local Study Area

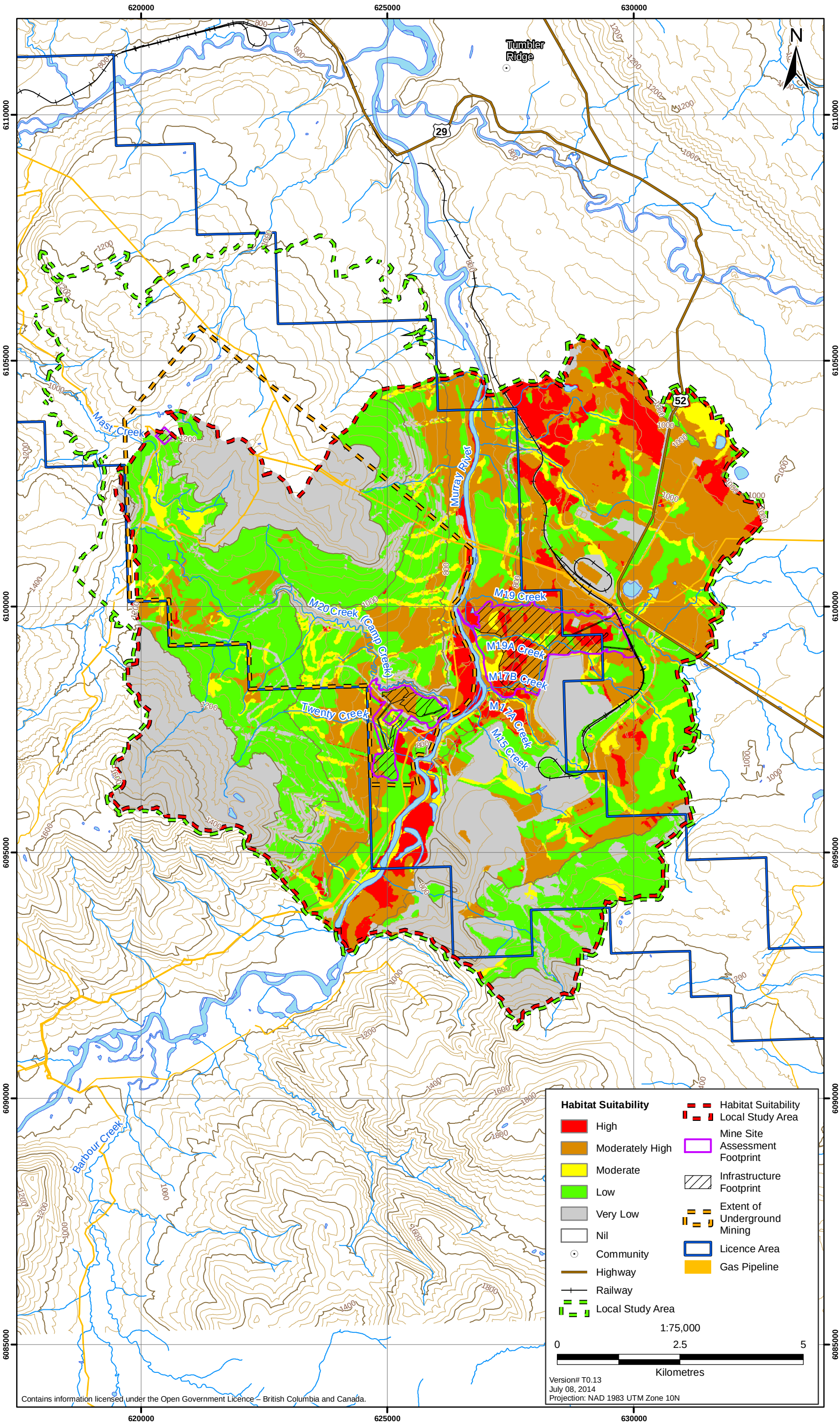
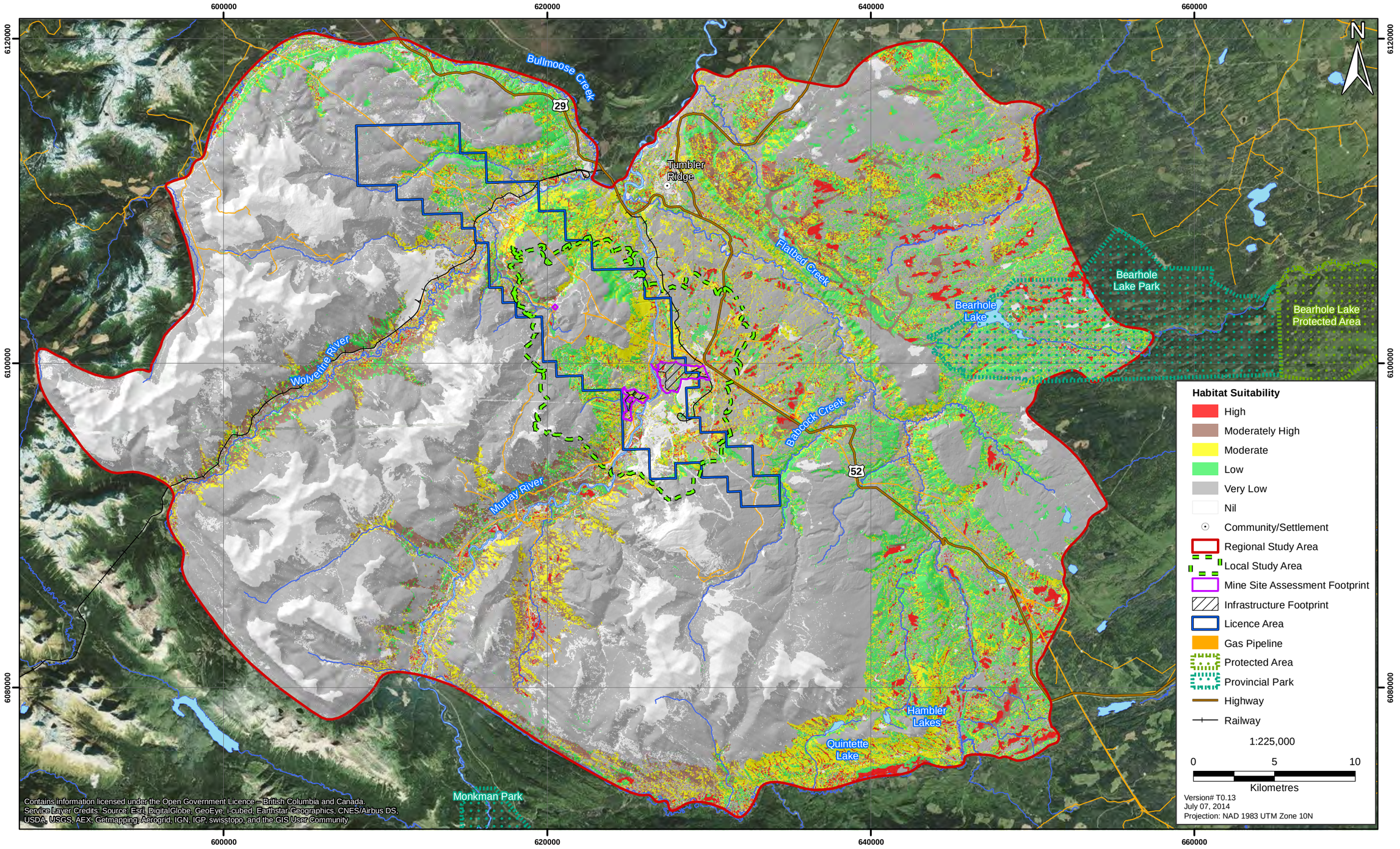


Figure 13.5-10
Moose: Winter Living Habitat in the Regional Study Area



Although the LSA is modelled to have more High rated growing living season habitat than winter living habitat, approximately half (56.3%) of the growing living habitat for moose within the LSA has a habitat suitability rating of Low (35.0%) or Very Low (21.3%; Table 13.5-4 and Figure 13.5-11). Suitable growing habitat for moose consisting of High (12.7%), Moderately High (18.7%), and Moderate (12.1%) rated habitat comprise 43.5% of the LSA (Table 13.5-4). This suitable habitat is primarily along the Murray River corridor and on the east side of the LSA, with a small amount located in the western side of the LSA (Figure 13.5-11). Suitable growing habitat, including High rated habitat, occurs within the Coal Processing Site with a small amount of Moderately High rated habitat located within the Shaft and Decline Site. Small amounts of Moderate, Moderately High, and High rated habitat are modelled within the extent of underground mining where subsidence may occur.

The majority of the RSA consisted of non-suitable habitat; Low (36.5%), Very Low (26.5%), or Nil (7.7%) rated habitat (Table 13.5-4). A little under a third of the RSA (29.3%) is rated as suitable growing living habitat for moose with the majority of this habitat classified as Moderate rated habitat (20.4%) and smaller portions of Moderately High (6.0%) and High (2.9%) rated habitat (Table 13.5-4). Suitable growing living habitat for moose was primarily located on the eastern side of the RSA with some suitable habitat located along low elevation areas of the major river tributaries such as the Murray and Wolverine Rivers (Figure 13.5-12).

13.5.4.4 Mountain Goat

Mountain goats receive conservation attention from the BC government because they are important for traditional harvest by Aboriginal peoples and recreational harvest for resident and non-resident hunters. Habitat for mountain goats is found throughout the province. The total number of mountain goats in BC was estimated at approximately 39,000 to 66,000 (BC MOE 2010b), with approximately 6% (2,000 – 4,000 individuals) estimated to occur in the Peace Region. The Peace Region population is reported to be stable (BC MOE 2010b).

Mountain goats are not a federally listed species, are globally assessed as widespread, abundant, and secure, and are provincially yellow-listed (B.C. Conservation Data Centre 2012). The BC MOE/ BC MFLNRO has identified areas of high-quality mountain goat winter habitat throughout the province, and has designated these areas as goat Ungulate Winter Ranges (UWRs). Within the Murray River RSA, there are several designated UWRs that apply to both caribou and mountain goat: UWR # U-9-002, units SPC 014 – 017, 034, 046, and 047. SPC 034 is primarily for mountain goats and secondary for caribou while the other designated areas are primary for caribou and secondary for mountain goats. However, only a small amount of unit SPC 034 is within the RSA.

For mountain goats, escape terrain is the most important factor that determines overall habitat suitability, regardless of season (Côté and Festa-Bianchet 2001; Poole, Stuart-Smith, and Teske 2006; Scheck et al. 2006; Hamel and Cote 2007). Factors such as elevation and aspect appear to influence mountain goat habitat suitability by season. The following general seasonal habitat requirements are expected for mountain goats.

Winter Season Living Requisites

In winter, snow depths influence available forage as well as the ability of mountain goats to escape predators. Winter living habitat requirements for mountain goats are typically associated with the following habitat attributes:

- Proximity to escape terrain (less than 400 to 500 m is most suitable);
- Windswept ridges and rocky outcrops;
- Alpine;
- Mature forests below treeline (extend at least 500 m lower than in summer);
- Warm aspects with lower snow depths and higher access to forage; and
- Winter forage consisting primarily of browse species not covered by snow.

The majority (84.6%) of the LSA is classified as non-suitable; Very Low (84.6%) and Low (6.5%) rated habitats for winter living (Table 13.5-5 and Figure 13.5-13). Suitable winter living habitat accounts for less than 10 percent of the LSA (8.7%) and consists of High (0.6%), Moderately High (7.8%), and Moderate (0.3%) rated habitat (Table 13.5-5). Compared to the other ungulates with habitat suitability modelling, mountain goat had the lowest percentage of suitable habitat in the LSA. Suitable habitat is modelled primarily in small clusters along the central and western side of the LSA with a small amount located in the south end of the LSA and on the east side of the Murray River (Figure 13.5-13). The majority of suitable winter living habitat for mountain goat is located outside of proposed areas of development although a very small proportion falls within both Mine Site Assessment Footprints as well as within the extent of underground mining where subsidence may occur.

The majority of the RSA (94.0%) is classified as Nil rated winter living habitat for mountain goat with a small amount (0.9% of RSA) of Low rated winter living habitat (Table 13.5-5). Very Low rated habitat does not occur within the RSA. A small portion (5.2%) is classified as suitable winter living habitat for mountain goat; Moderate 0.9%, Moderately High (2.2%), and High (2.1%) rated habitat (Table 13.5-5). Suitable winter living habitat is primarily located in high elevation areas on the western side of the RSA with a small amount located in high elevation areas in the southern portion of the RSA east of the Murray River (Figure 13.5-14). Areas of suitable habitat overlap the UWR within the RSA, with the exception that suitable habitat was not found on the east side of the RSA where portions of UWR are also located. The UWR is primarily for caribou, which is likely the reason that suitable habitat was not present on the eastern portion of the RSA, as it offers more suitable habitat for caribou rather than mountain goat.

Growing Season Living Requisites

Living habitat requirements for mountain goats during the growing season are typically associated with the following habitat attributes:

- Proximity to escape terrain;
- Primarily alpine habitat;
- Summer forage consisting of grasses, sedges and rushes; and
- Access to mineral licks in spring.

Figure 13.5-11

Moose: Growing Living Habitat in the Local Study Area

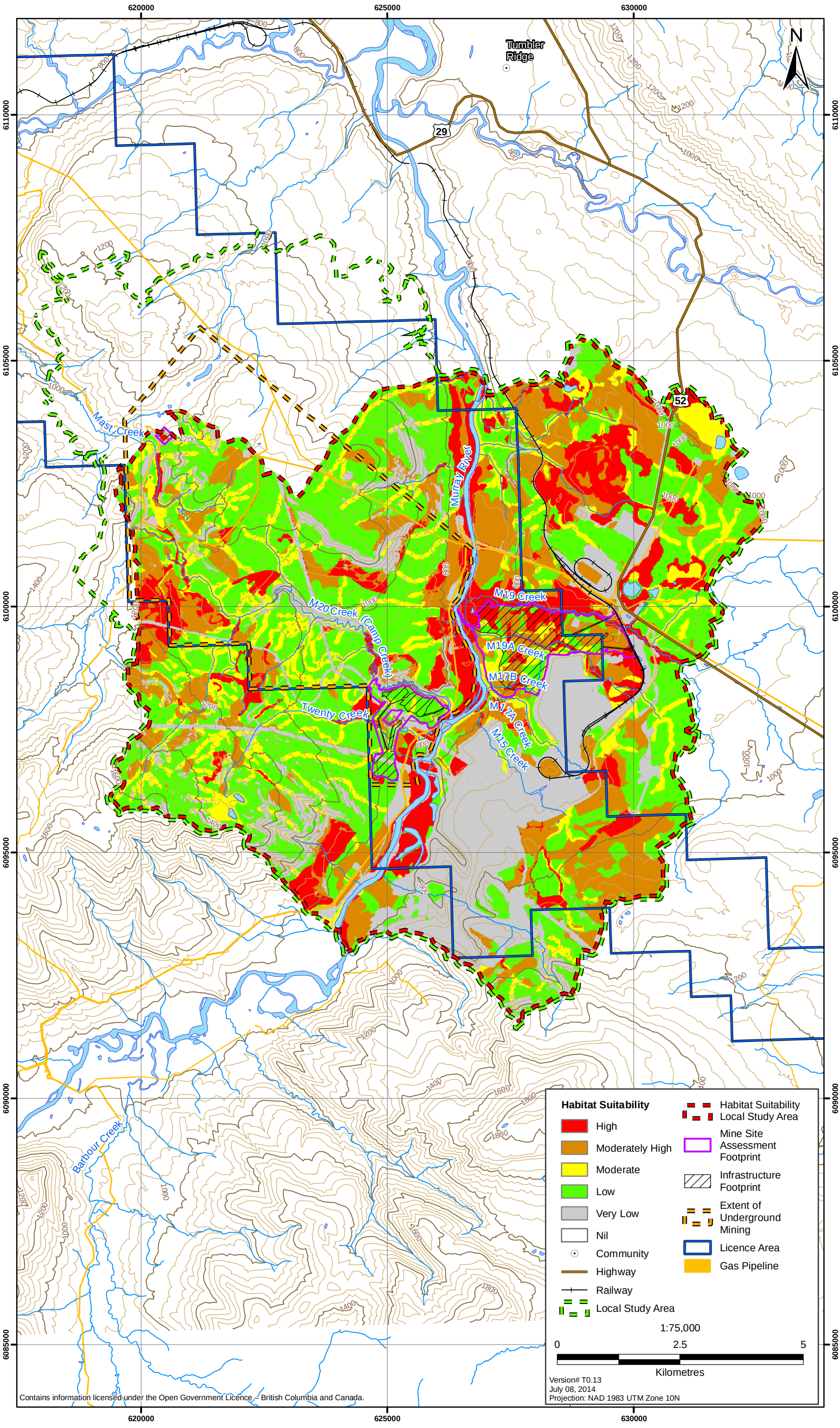


Figure 13.5-12
Moose: Growing Living Habitat in the Regional Study Area

ERM

600000 620000 640000 660000

6120000 6100000 6080000

Bullmoose Creek
29
Tumbler Ridge
Flatbed Creek
Bearhole Lake Park
Bearhole Lake
Bearhole Lake Protected Area
Wolverine River
Babcock Creek
52
Murray River
Hambler Lakes
Quintette Lake
Monkman Park

N

Habitat Suitability
- High
- Moderately High
- Moderate
- Low
- Very Low
- Nil
- Community/Settlement
- Regional Study Area
- Local Study Area
- Mine Site Assessment Footprint
- Infrastructure Footprint
- Licence Area
- Gas Pipeline
- Protected Area
- Provincial Park
- Highway
- Railway

1:225,000

0 5 10
Kilometres

Version# T0.13
July 08, 2014
Projection: NAD 1983 UTM Zone 10N

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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 13.5-13

Mountain Goat: Winter Living Habitat in the Local Study Area

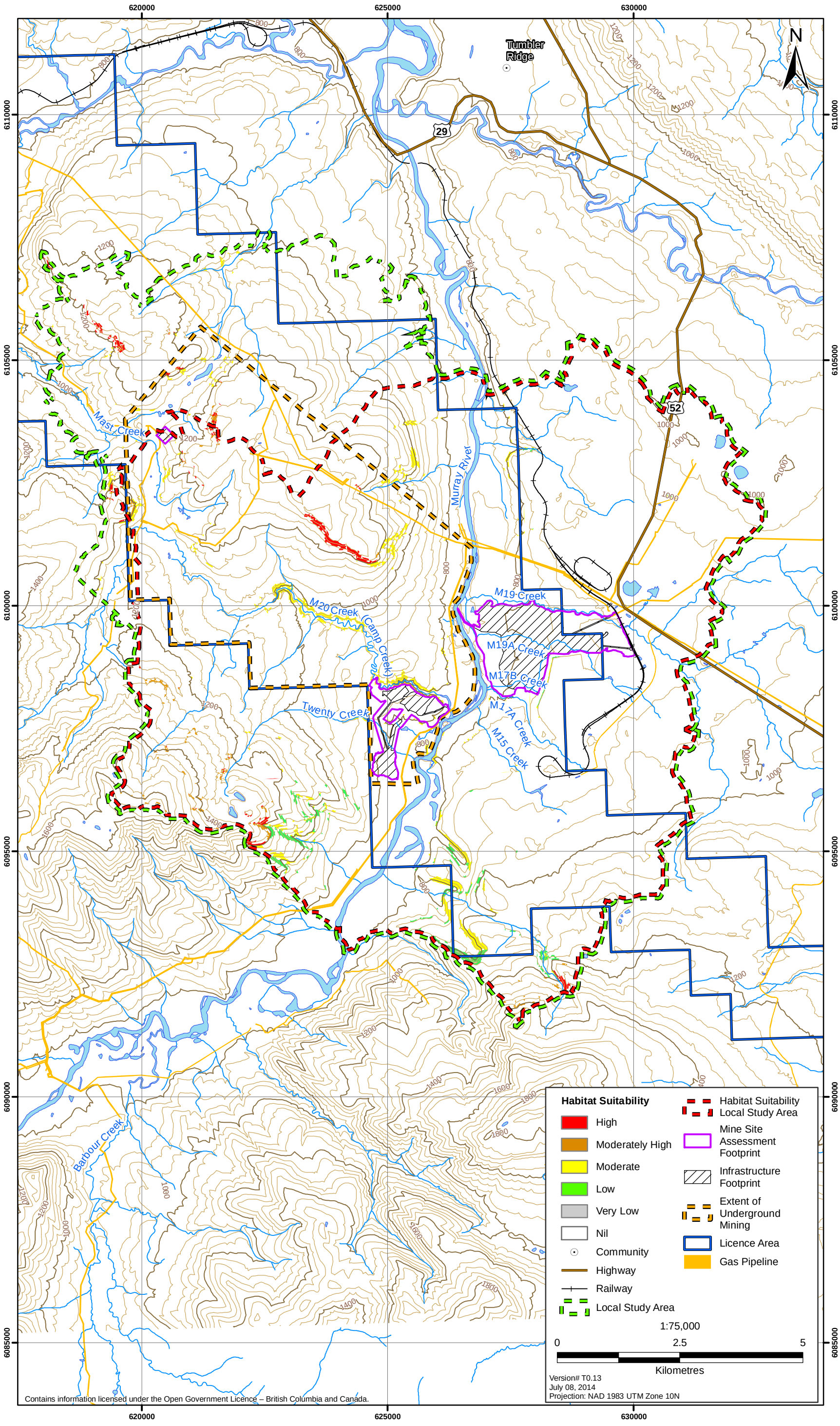


Figure 13.5-14
Mountain Goat: Winter Living Habitat in the Regional Study Area

ERM

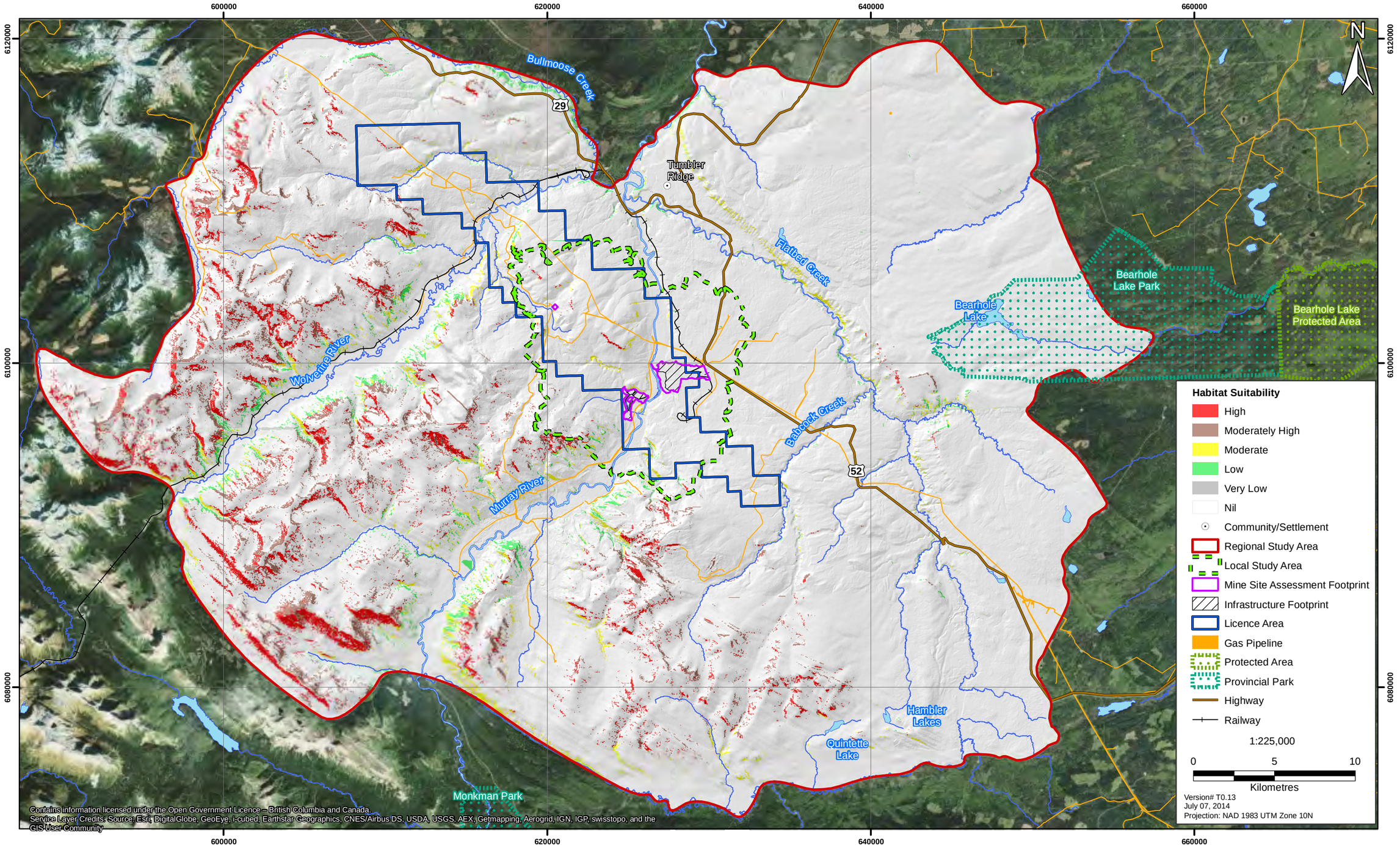


Table 13.5-5. Area and Proportion of Habitat within the Local Study Area and Regional Study Area for Mountain Goat

	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
Suitability Rating	Area (ha)[1]	% of LSA[2]	Area (ha)[1, 3]	% of RSA[2]
Winter Living				
High	68	0	4,680	2
Moderately High	ile	7	4,960	2
Moderate	41	0	1,957	0
Low	791	6	2,016	0
Very Low	10,232	84	0	0
Nil	0	0	213,993	94
Unclassified	14	0	0	0
Growing Living				
High	656	5	9,641	4
Moderately High	898	7	0	0
Moderate	1,341	11	0	0
Low	260	2	3,974	1
Very Low	8,921	73	0	0
Nil	0	0	213,993	94
Unclassified	14	0	0	0

[1] LSA = 12,092 ha and RSA = 227,615.8 ha.
[2] For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100% (e.g., 99% or 101%).
[3] Includes area of LSA.

Although the LSA offers more suitable growing living habitat as compared to suitable winter living habitat, the majority (73.8%) of the growing living habitat for mountain goat within the LSA still has a habitat suitability rating of Very Low (Table 13.5-5 and Figure 13.5-15). Suitable growing habitat for mountain goat consisting of High (5.4% of LSA), Moderately High (7.4% of LSA), and Moderate (11.1% of LSA) rated habitat amounts to a little over 20 percent (23.9%) of the LSA (Table 13.5-5). This is modelled as primarily in small clusters along the central and western side of the LSA with a small amount located in the south end of the LSA and on the east side of the Murray River (Figure 13.5-15). The majority of suitable growing living habitat is located outside of proposed areas of development; however, a very small proportion falls within the east and west Mine Site Assessment Footprints, including High rated habitat along Twenty Creek and M20 Creek, as well as within the extent of underground mining where subsidence may occur.

Of the ungulates that had habitat suitability modelling, mountain goat has the lowest percentage of suitable living habitat during the growing season. Very little area within the RSA (4.2%) is classified as suitable growing living habitat for mountain goat although all of it was classified as High rated habitat. Suitable growing living habitat for mountain goat was located along high elevation ridges primarily on the western side of the RSA with a small amount located in high elevation areas in the southern portion of the RSA east of the Murray River (Figure 13.5-16). The majority of the RSA (95.7%) was classified as Nil (94.0% of RSA) or Low (1.7% of RSA) growing living habitat for mountain goat (Table 13.5-5).

13.5.4.5 Elk

Elk are not a federally listed species, are globally assessed as widespread, abundant, and secure, and provincially yellow-listed (BC CDC 2013). There is one UWR (U-9-001, SPE-023) for elk, mule deer and moose just outside of the RSA, north of Bullmoose Creek. Rocky Mountain elk are a subspecies found mainly across the south-central, southeast, and northeast regions of BC (Shackleton 1999; Arthur 2003). They are found in all of the ecoprovinces in BC with the exception of four; Coast and Mountains, Georgia Depression, Central Interior, and the Taiga Plains (Arthur 2003).

The RSA overlaps with the Peace-Liard region; the elk population is mostly sparse, although there are some areas with higher densities including the Murray River area. The population of Rocky Mountain elk in northern BC, which includes the Peace-Liard region and neighboring Omineca region, is estimated at approximately 6,200 elk (Hengeveld and Wood 2001).

Elk usually inhabit mountainous areas, although they do not necessarily require steep landscapes (BC MOE 2000). Habitat selection by elk in all seasons is a balance between the presence of suitable forage with cover and other influences such as predation, human activities, and snow cover (Goddard 2003). The living requisite for elk primarily depends on security/thermal requirements and forage. The following general seasonal habitat requirements are expected for elk in the RSA.

Winter Season Living Requisites

Elk winter habitat is determined by forage availability, quantity, and quality, snow depths, thermal security, and potentially the amount of disturbance (Goddard 2003). Winter living habitat requirements for elk are typically associated with the following habitat attributes:

- Early to mid seral stage areas, particularly burns and cutblocks, and mature stands with herbaceous understory with structural stages 2, 3, and 6, and 7 for foraging;
- Riparian areas and river breaks and other areas including agricultural areas and wetlands;
- South-facing aspects;
- Gentle slopes (generally < 30%);
- Below 1,000 m in elevation;
- Winter forage species including grasses (e.g. *Elymus innovates*, *Calamagrostis canadensis*, *Oryzopsis* spp.), willow, Saskatoon, rose and other shrubs and sedges and horsetails in wetland habitat;
- Coniferous-dominated forest stands to provide shelter and thermal security;
- Trees greater than 10 m in height;
- Canopy closure of greater than 70%; and
- Structural stages 4 to 7 for security and thermal purposes.

Figure 13.5-15

Mountain Goat: Growing Living Habitat in the Local Study Area

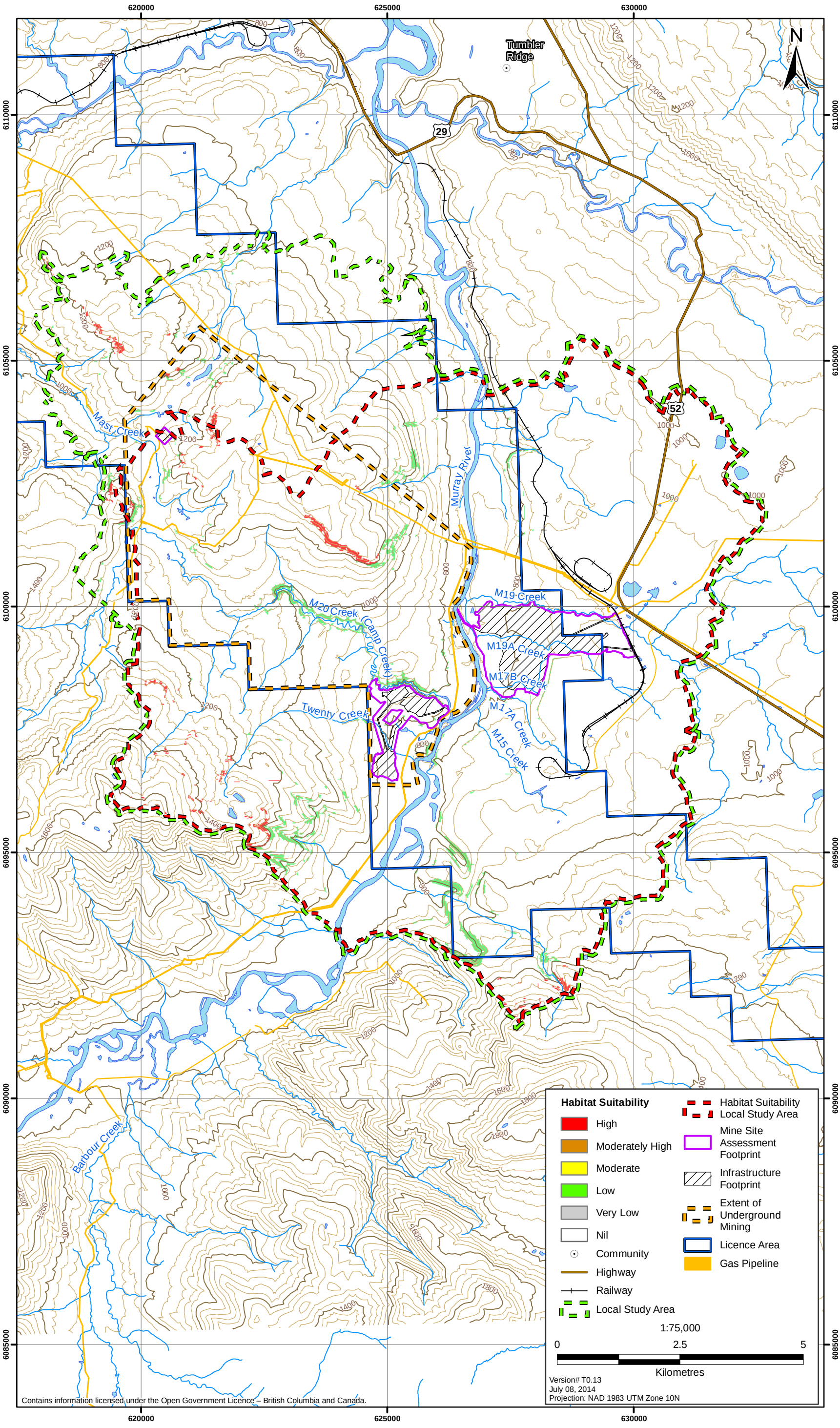
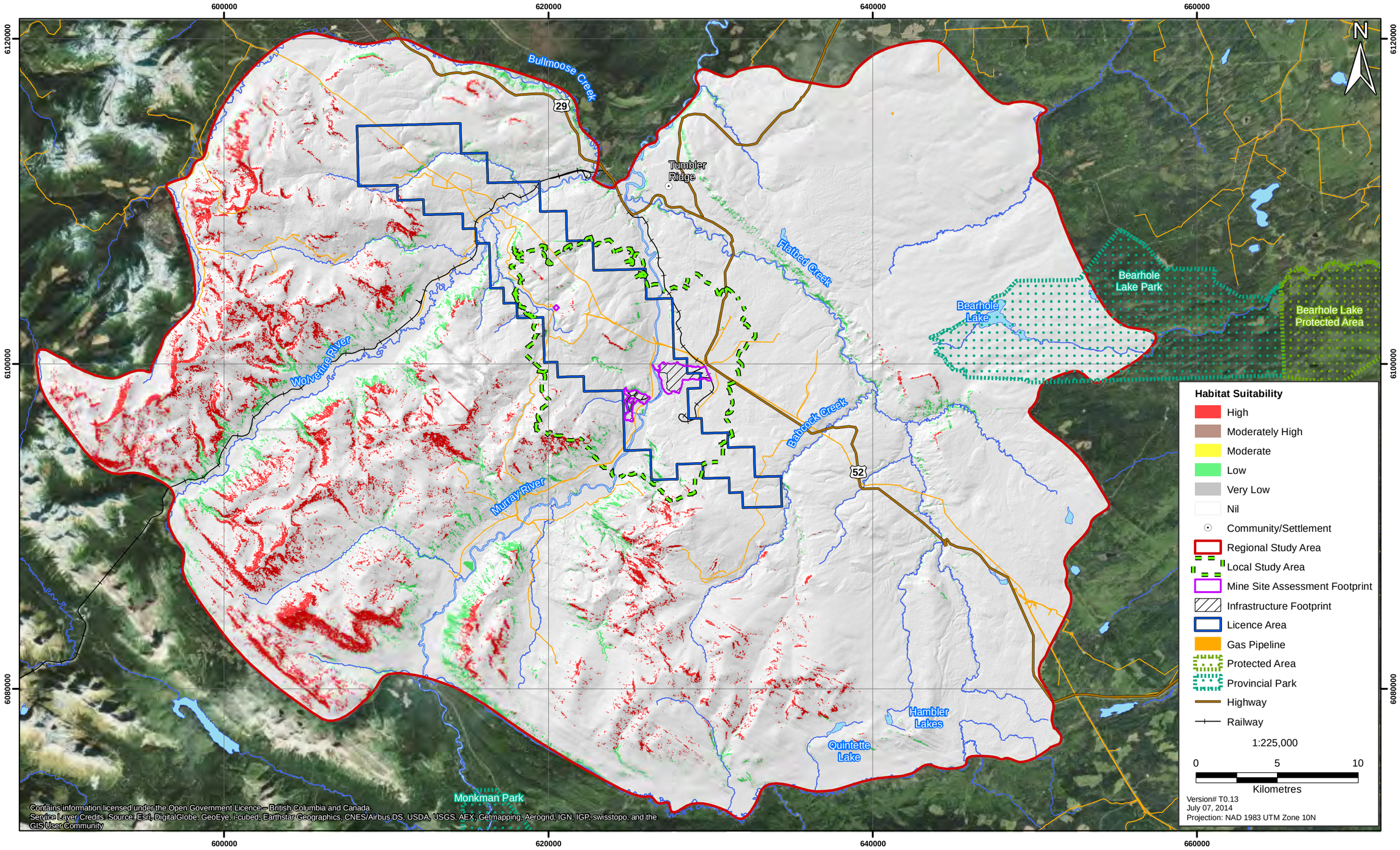


Figure 13.5-16
Mountain Goat: Growing Living Habitat in the Regional Study Area

ERM



The majority (85.4%) of winter season living habitat for elk within the LSA has a habitat suitability rating of Low (48.0% of LSA) or Very Low (37.4% of LSA; Table 13.5-6 and Figure 13.5-17). Suitable winter living habitat amounts to just under 15% within the LSA; 10.3% Moderate, 2.3% Moderately High, and 1.8% High rated habitat (Table 13.5-6). This area is primarily in small pockets on the north east side of the LSA with a small amount in the south and central portion of the LSA on either side of the Murray River (Figure 13.5-17). A small amount of suitable winter living habitat for elk occurs within both Mine Site Assessment Footprints and along the southeast side of the extent of underground mining.

Table 13.5-6. Area and Proportion of Habitat within the Local Study Area for Elk

	Amount of Habitat in the LSA	
Suitability Rating	Area (ha)[1]	% of LSA[1]
Winter Living		
High	219	1
Moderately High	275	2
Moderate	1,251	10
Low	5,809	48
Very Low	4,519	37
Nil	0	0
Unclassified	17	0
Growing Living		
High	349	2
Moderately High	2,864	23
Moderate	1,728	14
Low	5,264	43
Very Low	1,868	15
Nil	0	0
Unclassified	17	0

[1] LSA = 12,092 ha.

[2]For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100% (e.g., 99% or 101%).

Growing Season Living Requisites

During the growing season (spring, summer, and fall), elk tend to utilize a broader variety of habitat (Peck and Peek 1991). Habitat requirements for elk during the growing season are typically associated with the following habitat attributes:

- In spring, low elevation valley-bottom and low to mid elevation forest stands in early to mid-seral stage, riparian and alluvial areas, burns, cutblocks, and wetlands;
- In summer, north-facing slopes, subalpine and alpine basins and avalanche tracks with later green up, for feeding;
- Increased use of high elevations (i.e. ESSF, BAFA) compared to winter;

- Structural stages ranging from 2 to 7, with a preference for 2 and 3, and 6 and 7 if there is suitable herbaceous cover in the understory;
- Grasses, sedges and forbs;
- Cultivated fields with crops such as alfalfa and clover;
- Coniferous or coniferous-dominated forest stands for security cover;
- Forest stands greater than 3 m tall and 100 m wide; and
- Structural stages 4 to 7 for security.

Similar to caribou, mountain goat, and moose, the LSA was modelled as having more elk growing season habitat than winter season living habitat. Elk and moose had the higher percentages of suitable living habitat during the growing season within the LSA. However, the majority (59.0%) of growing living habitat for elk within the LSA has a habitat suitability rating of Low (43.5% of LSA) or Very Low (15.5% of LSA; Table 13.5-6 and Figure 13.5-18). Suitable growing living habitat for elk consisting of High (2.9%), Moderately High (23.7%), and Moderate (14.3%) rated habitat amounts to approximately 40% of the LSA and was located primarily in small pockets along the eastern side of the LSA with Moderately High and Moderate habitat located on the western and northwest side of the LSA (Figure 13.5-18). A small amount of suitable habitat occurs within both Mine Site Assessment Footprints, including High rated habitat along the tributary that borders the northern edge of the Coal Processing Site. Some Moderately High rated habitat also occurs within the northwestern extent of underground mining.

13.5.4.6 Grizzly Bear

Two species of bears occur in British Columbia that are expected in the RSA; black bear and grizzly bear. Specific surveys were not conducted for bears; however, incidental data was collected in 2010. Bear observations or sign, suitable habitat, and associated UTM location was recorded when possible. One black bear and one grizzly bear were observed within the LSA. A black bear mother with two cubs was observed within the RSA south of Wolverine River. An additional grizzly bear was also observed within the RSA, as well as an excavation on the west side of the RSA and high-quality spring habitat south of Wolverine River.

A habitat suitability model was created for grizzly bears. Mapping of the Habitat Suitability in the LSA was performed using TEM and outside of this area, PEM was used. Therefore, habitat suitability figures of the LSA and RSA will include both TEM and PEM mapping. Habitat was rated in six categories: High, Moderately High, Moderate, Low, Very Low, and Nil. Suitable habitat includes High, Moderately High, and Moderate categories while non-suitable habitat includes Low, Very Low, and Nil categories. A very small amount (0.1% – 0.2%) of the LSA was unclassified due to logistics with the data, but likely represents a similar proportional distribution of habitat quality within the LSA.

Figure 13.5-17

Elk: Winter Season Living Habitat Suitability in the Local Study Area

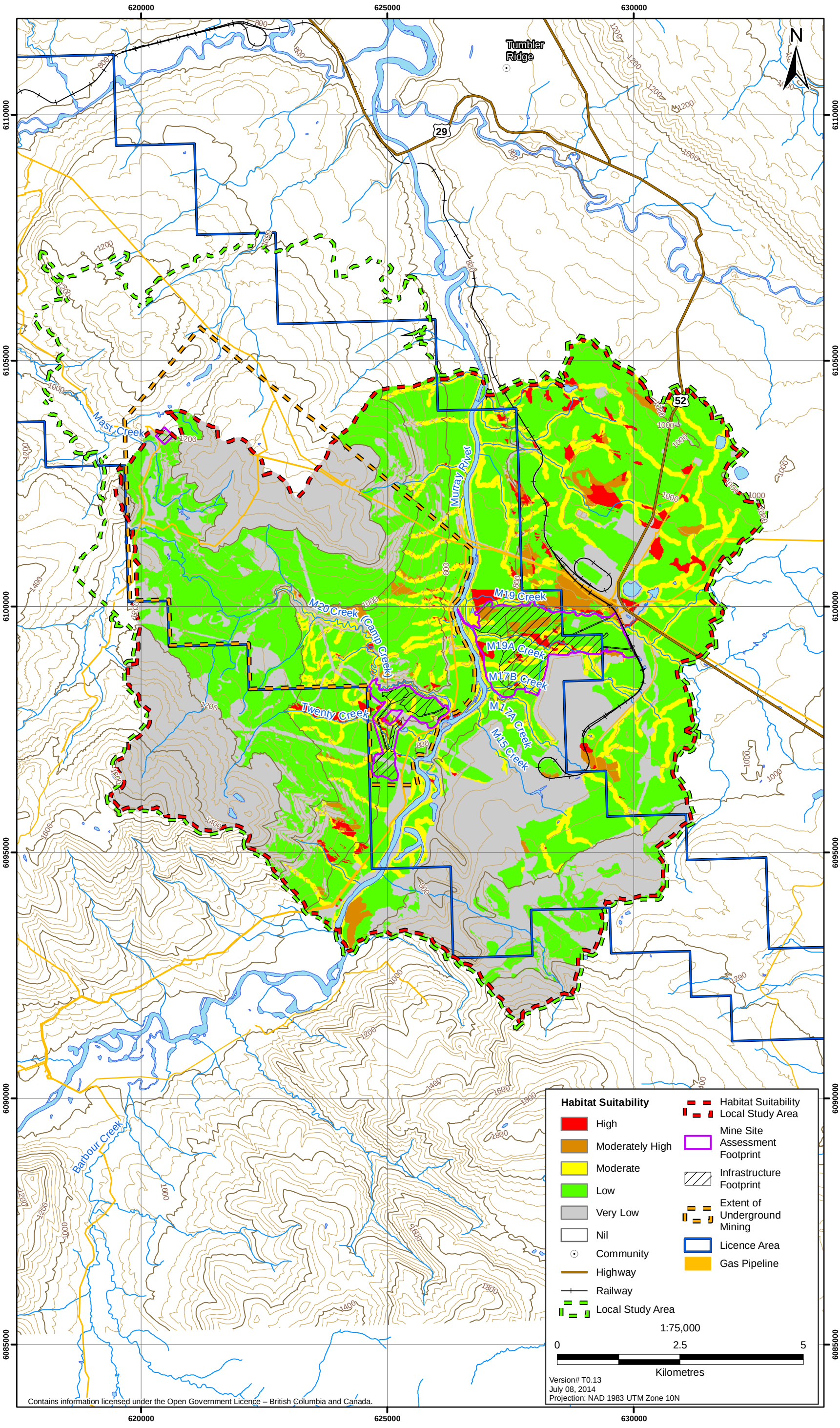
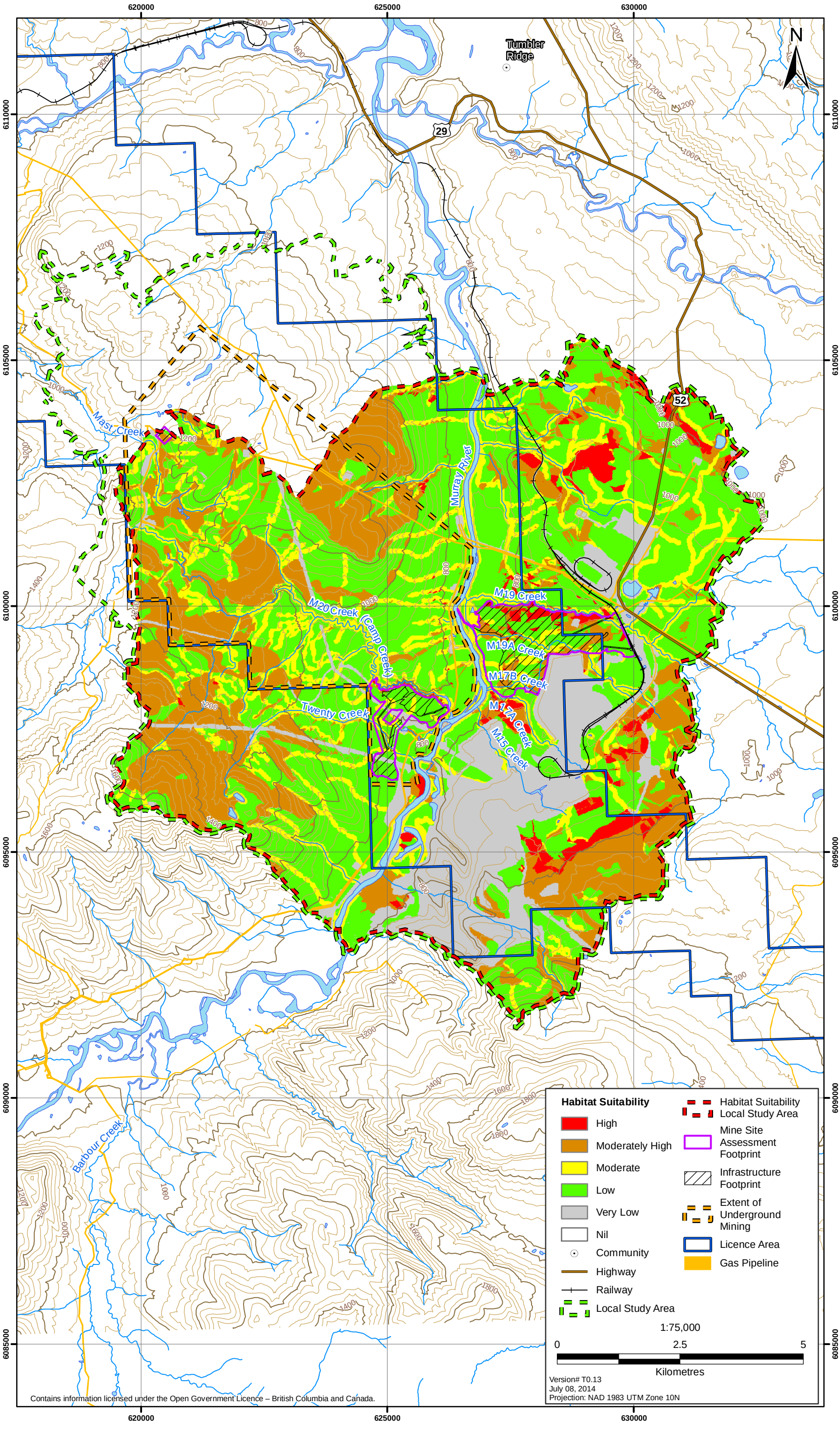


Figure 13.5-18

Elk: Growing Season Living Habitat Suitability in the Local Study Area



Grizzly bears (*Ursus arctos*) are listed as Special Concern by COSEWIC and are blue-listed in BC (BC CDC 2013). Grizzly bears were also assessed sub-nationally in 2010 by NatureServe, and were given an S3 status, which means they are vulnerable to extirpation within the province (BC CDC 2013). Under the provincial BC Conservation Framework priority system, conservation goals are ranked out of 6 with 1 being the highest priority. The goal of preventing species and ecosystem function from becoming at risk was given a 2 for grizzly bears; a 3 was given to both goals of global efforts for species and ecosystem conservation, as well as maintaining the diversity of native species and ecosystems.

Grizzly bear populations are managed for harvest throughout BC and are a significant social and economic element for Aboriginal peoples, resident hunters, and non-resident hunters. Grizzly bears are an Identified Wildlife Element under the Government of BC IWMS, and therefore require special conservation measures within the province (BC MWLAP 2004a, 2004e). They are also considered an umbrella wildlife species. Umbrella species are species that, due to their large home ranges and habitat requirements, may act as a proxy for other species with similar or smaller homes range or life requisites if conservation measures are adequate to protect the umbrella species (Roberge and Angelstam 2004).

Grizzly bears are found throughout BC, from sea level and river valleys to alpine regions. British Columbia contains more than 50% of the Canadian population of grizzly bears, with an estimated 13,800 grizzlies in the province (Gyug, Hamilton, and Austin 2004). The distribution of grizzly bears is often related to food supply, with higher densities along streams during salmon runs and on alpine and subalpine slopes when berries are abundant (Hamilton 1987). Grizzly bear management in BC is organized by grizzly bear population units (GBPUs). Grizzly bears found within the RSA are members of the Hart Grizzly Bear Population Unit which is 19,661 km^2. In 2004, the population estimate for the Hart GBPU was 386 bears, with a density of 20 bears per 1000 km^2 (Hamilton and Austin 2004).

Grizzly bears occupy a wide variety of habitats throughout the province. In the interior of BC, general patterns have been documented for the seasonal habitat use by grizzly bears, and seasonal movements are based on food availability and other factors such as sex, age, and social status. Based on the distribution and observed use of habitats from studies on interior grizzly bears (McLellan and Hovey 2001), and studies conducted in the adjacent Parsnip River area (L.M. Ciarniello, Seip, and Heard 2003), the following general seasonal habitat requirements are expected for grizzly bears in the RSA.

Winter Hibernating Requisites

Winter hibernation by grizzly bears is generally associated with the following habitat attributes:

- Subalpine krummholz, parkland, and alpine tundra; and
- Natural caves for natal dens, when available.

A small portion of the RSA (8.0%) is rated as suitable winter hibernating habitat for grizzly bear; 5.1% High, 2.8% Moderately High, and 0.1% Moderate rated habitat (Table 13.5-7). Suitable winter hibernating habitat is located in subalpine and alpine areas primarily on the western side of the RSA, as well as in alpine and subalpine areas in the southern portion of the RSA (east of

the Murray River; Figure 13.5-19). The remainder and majority (91.9%) of the RSA consists of non-suitable winter hibernating habitat; 38.6% Low, 52.3% Very Low, and 1.0% Nil rated habitat (Table 13.5-7).

Table 13.5-7. Area and Proportion of Habitat within the Local Study Area and Regional Study Area for Grizzly Bear

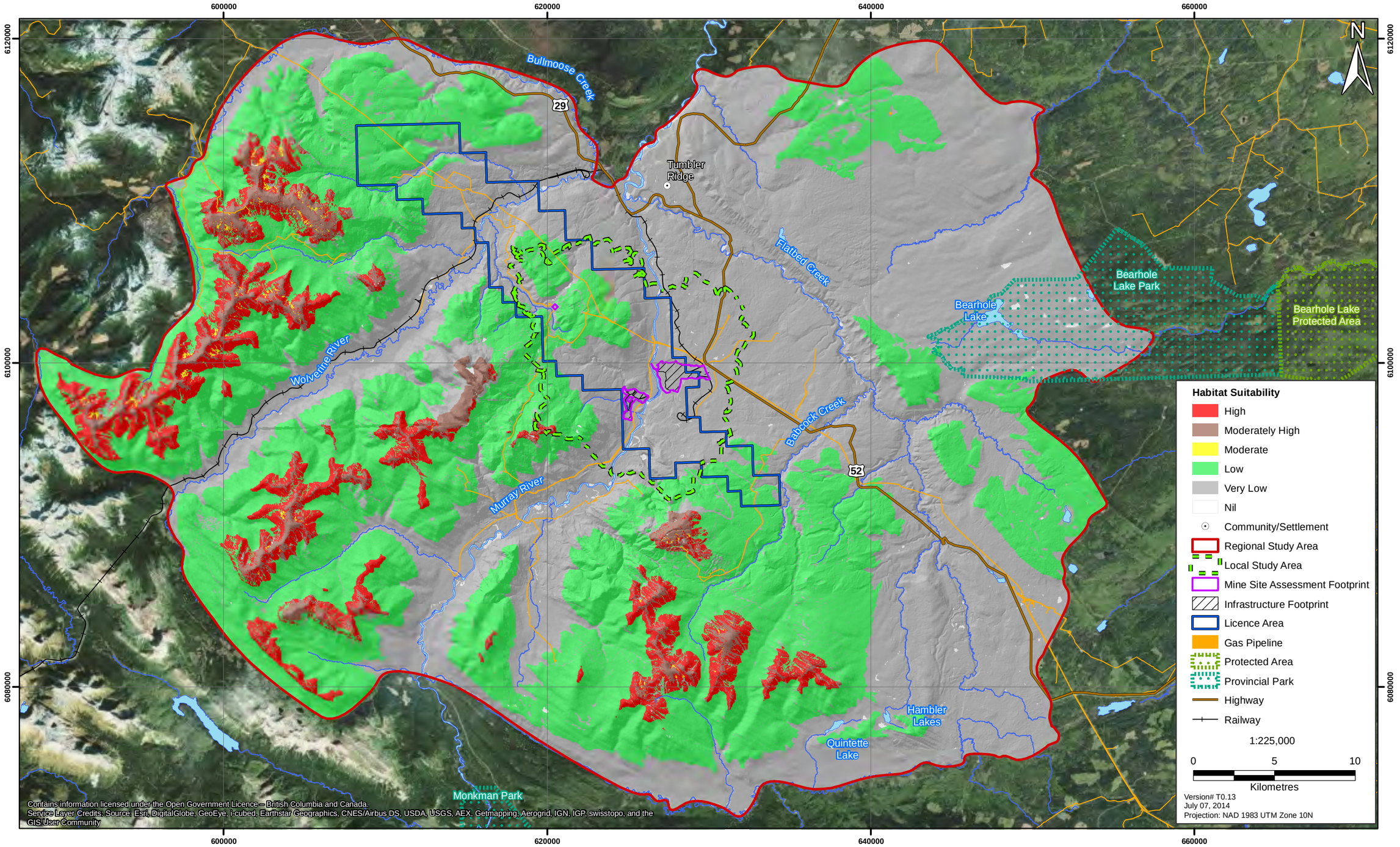
	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
Suitability Rating	Area (ha)[1]	% of LSA[2]	Area (ha)[1, 3]	% of RSA[2]
Winter Hibernating				
High	NA	NA	11,567	5
Moderately High	NA	NA	6,448	2
Moderate	NA	NA	322	0
Low	NA	NA	87,926	38
Very Low	NA	NA	119,132	52
Nil	NA	NA	2,179	1
Unclassified	NA	NA	39	0
Spring Living				
High	886	7	866	0
Moderately High	720	6	6,276	3
Moderate	2,272	19	29,369	13
Low	4,398	36	128,578	56
Very Low	3,794	31	43,309	19
Nil	0	0	19,176	8
Unclassified	19	0	39	0
Summer Living				
High	2,222	18	2,158	1
Moderately High	1,192	10	40,836	18
Moderate	3,173	26	87,785	39
Low	1,886	16	75,867	33
Very Low	3,606	30	13,094	6
Nil	0	0	7,833	3
Unclassified	10	0	39	0
Fall Living				
High	358	3	2,158	1
Moderately High	3,100	26	88,294	39
Moderate	2,367	20	56,284	25
Low	2,047	17	45,602	20
Very Low	4,202	35	16,015	7
Nil	0	0	19,221	8
Unclassified	17	0	39	0

[1] *LSA = 12,092 ha, RSA = 227,615.8 ha, and NA = Not Assessed.*

[2] *For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100% (e.g., 99% or 101%).*

[3] *Includes area of LSA.*

Figure 13.5-19
Grizzly Bear: Winter Hibernating Habitat in the Regional Study Area



Spring Season Living Requisites

After emerging from their dens, grizzly bears spend most of their time in the spring foraging, feeding primarily on herbaceous forbs and grasses. The following habitat attributes are typically used by interior grizzly bears during the spring:

- South-facing slopes with well-developed soil;
- Lower elevation valley bottoms with open forest canopies; and
- South-facing herbaceous avalanche tracks cleared of snow.

Suitable spring living habitat for grizzly bear consists of High (7.3%), Moderately High (6.0%), and Moderate (18.8%) rated habitat; it amounts to just under a third of the LSA (32.1%; Table 13.5-7). Suitable habitat is located primarily along the central portion of the LSA near the Murray River corridor and on the northeast side of the LSA with a small amount located on the west side of the LSA (Figure 13.5-20). High rated spring living habitat occurs within the Coal Processing Site and is located north of the Shaft and Decline Site within the extent of underground mining. Larger portions are also along the northern LSA boundary around Murray River and to the east. The majority (67.8%) of spring living habitat for grizzly bear within the LSA is classified as non-suitable; 36.4% Low and 31.4% Very Low rated habitat (Table 13.5-7 and Figure 13.5-20). There is no habitat classified as Nil occurring within the LSA.

Similar to the LSA, a small portion of the RSA (16.1%) is rated as suitable spring living habitat for grizzly bear; 12.9% Moderate, 2.8% Moderately High, and 0.4% High rated habitat (Table 13.5-7). Suitable spring living habitat is located in lower elevation areas primarily in valley bottoms along the major river tributaries, such as Murray River and Wolverine River (Figure 13.5-21). The majority of the RSA consisted of non-suitable spring living habitat; 56.5% Low, 19.0% Very Low, and 8.4% Nil rated habitat (Table 13.5-7).

Summer Season Living Requisites

Summer feeding areas are the most variable of the seasonal habitats and use depends on factors such as food availability, sex, reproductive status, age, competition with other bears, and interactions with humans. The following habitat attributes are typically used by interior grizzly bears during the summer:

- Subalpine meadows and alpine tundra excluding rock, ice and snow, predominantly alpine meadows, herb fields and grasslands;
- Krummholz subalpine fir/slide alder/rhododendron communities;
- Early-seral stage openings (i.e. burns and cutblocks) with high berry production;
- Herbaceous and shrubby avalanche tracks, especially north-facing; and
- Mid-elevation cool aspects.

Just over half (54.5%) of summer living habitat for grizzly bear within the LSA is classified as suitable habitat; 18.4% High, 9.9% Moderately High, and 26.2% Moderate (Table 13.5-7 and Figure 13.5-22). These areas are located primarily on the western and southeastern portions of the

LSA, with a small amount located in the northeast portion of the LSA (Figure 13.5-22). High rated habitat occurs in small areas within the Coal Processing Site. Larger High rated areas are located along the western, northwestern, and southeastern RSA boundaries; the habitat along the northwestern RSA boundary is within the extent of underground mining. The remainder of the LSA (45.4%) consists of non-suitable habitat that was rated as Low (15.6%) or Very Low (29.8%). Nil classified summer living habitat does not occur within the LSA.

Within the RSA, slightly more than half (57.4%) is rated as suitable summer living habitat for grizzly bears; 38.6% Moderate, 17.9% Moderately High, and 0.9% High rated habitat (Table 13.5-7). Suitable summer living habitat for grizzly bear is located in the mid-elevation zone within subalpine and alpine areas, which are primarily located on the western side and southern portion of the RSA. Smaller areas of Moderate and Moderately High rated habitat occur in the east and north portions of the RSA (Figure 13.5-23). The remainder of the RSA (42.5%) consists of Low (33.3%), Very Low (5.8%), and Nil (3.4% of RSA) rated summer living habitat for grizzly bears (Table 13.5-7).

Fall Season Living Requisites

In fall, grizzly bears continue to use non-forested high-elevation alpine habitats, similar to those used in the summer. The following habitat attributes are typically used by interior grizzly bears during the fall:

- Predominantly alpine tundra excluding rock and ice, meadow, herb fields and grasslands;
- Young-seral stage openings (i.e. burns and cutblocks) with high berry production; and
- Mid to high elevations.

Suitable and non-suitable living habitat each occupied approximately half of the LSA during both summer and fall seasons. Just under half (48.2%) of the LSA is classified as suitable fall living habitat for grizzly bear; 3.0% High, 25.6% Moderately High, and 19.6% Moderate rated habitat (Table 13.5-7). The majority of suitable habitat is located on the western side of the RSA (Figure 13.5-24). High rated habitat was found in a few small areas within the Coal Processing Site, and additional areas within the extent of underground mining. Larger portions of High rated habitat are found along the southeastern LSA boundary. The remainder of the LSA is classified as non-suitable habitat (51.6%); this consists of Low (16.9%) and Very Low (34.7%) rated habitat (Table 13.5-7). Nil rated habitat was not present within the LSA.

Within the RSA, approximately two thirds (64.4%) of the area consists of suitable fall living habitat for grizzly bear; 0.9% High, 38.8% Moderately High, and 24.7% Moderate rated habitat (Table 13.5-7). Suitable fall habitat occurs in mid to high elevation areas throughout the RSA (Figure 13.5-25). High rated suitable fall living habitat for grizzly bear was primarily located in alpine and tundra areas of mid- to high elevation, along the western side of the RSA. The remainder of the RSA consists of non-suitable habitat comprised of Low (20.0%), Very Low (7.0%), and Nil (8.4%) rated fall living habitat for grizzly bear (Table 13.5-7).

Figure 13.5-20

Grizzly Bear: Spring Living Habitat in the Local Study Area

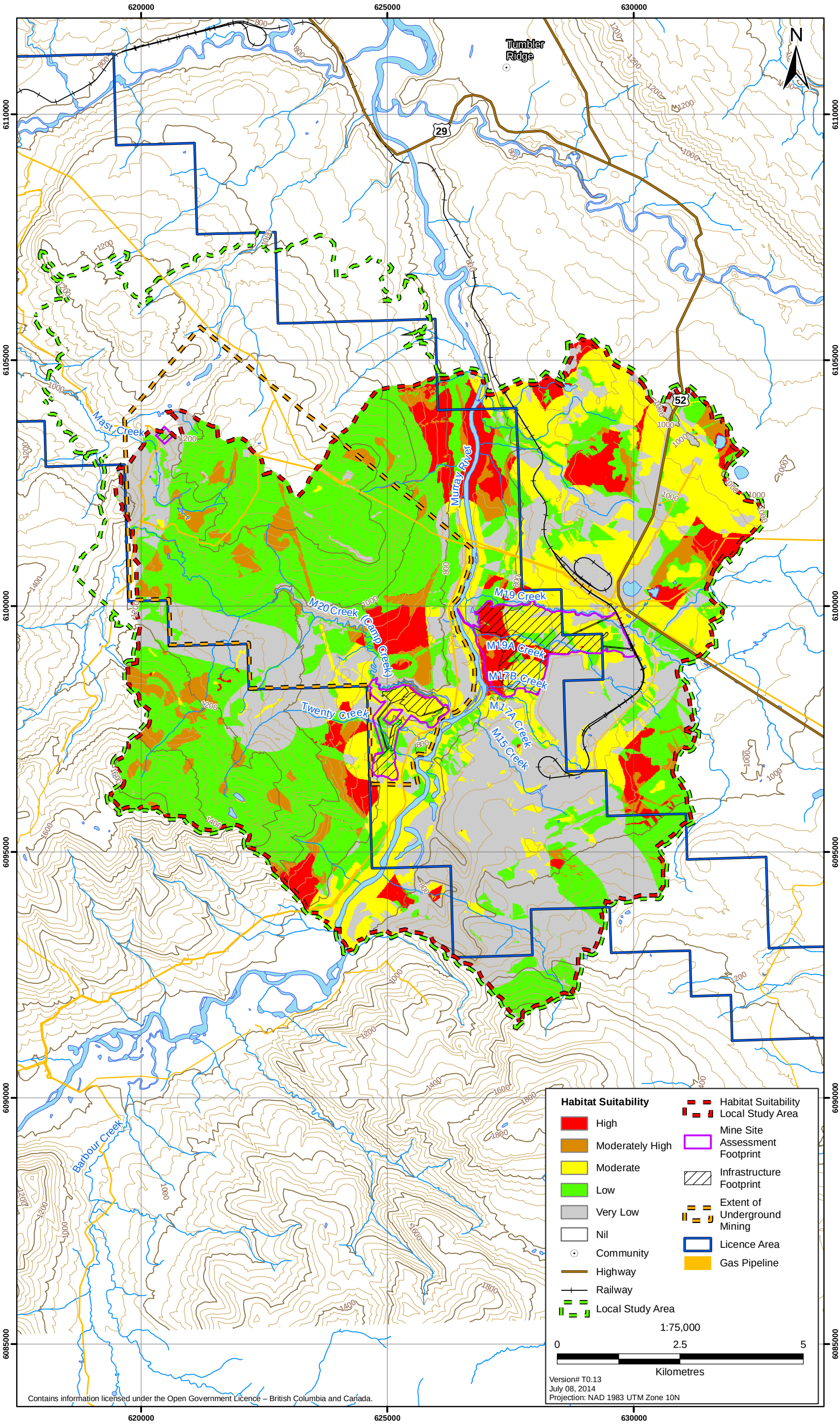


Figure 13.5-21
Grizzly Bear: Spring Living Habitat in the Regional Study Area

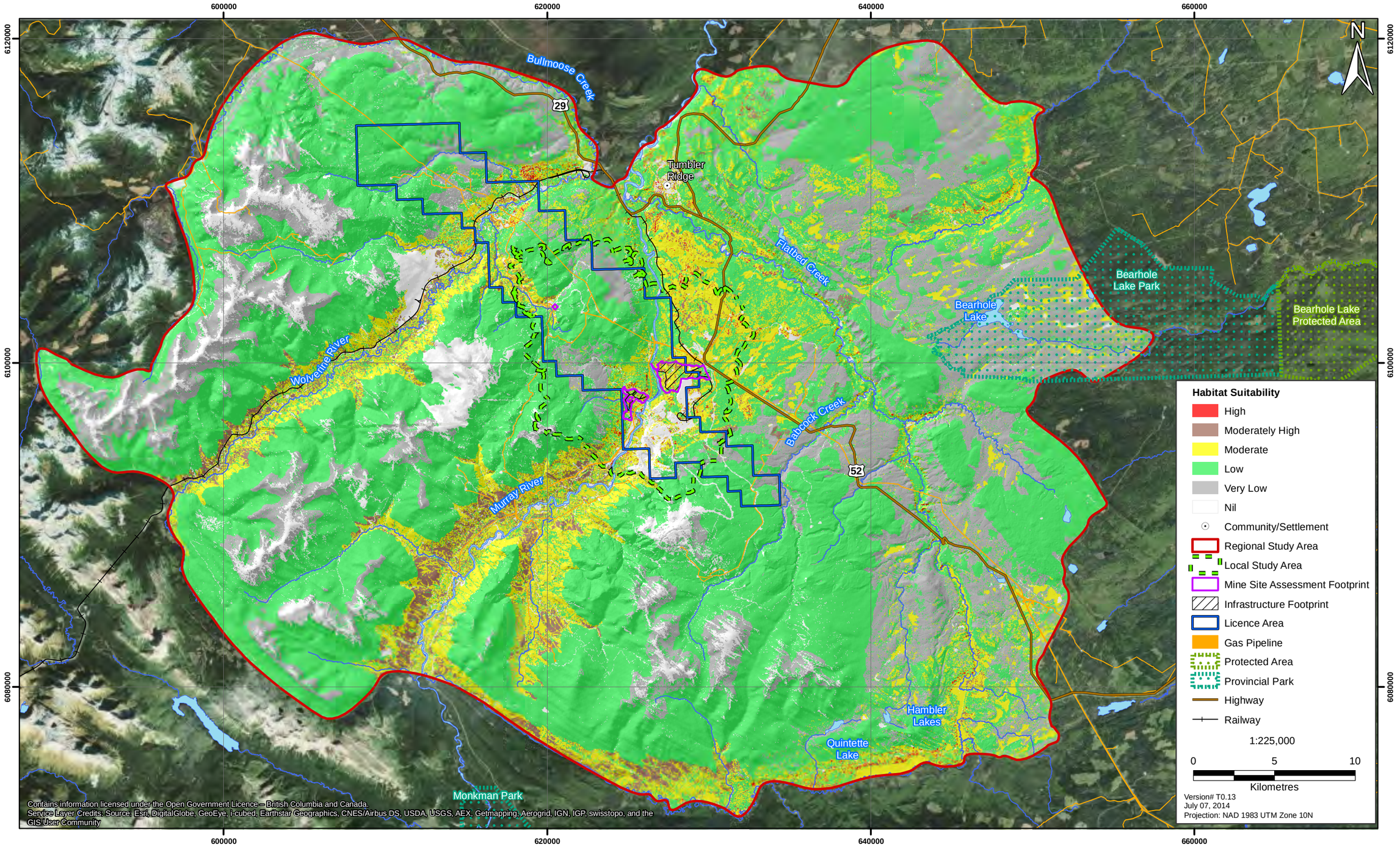


Figure 13.5-22

Grizzly Bear: Summer Living Habitat in the Local Study Area

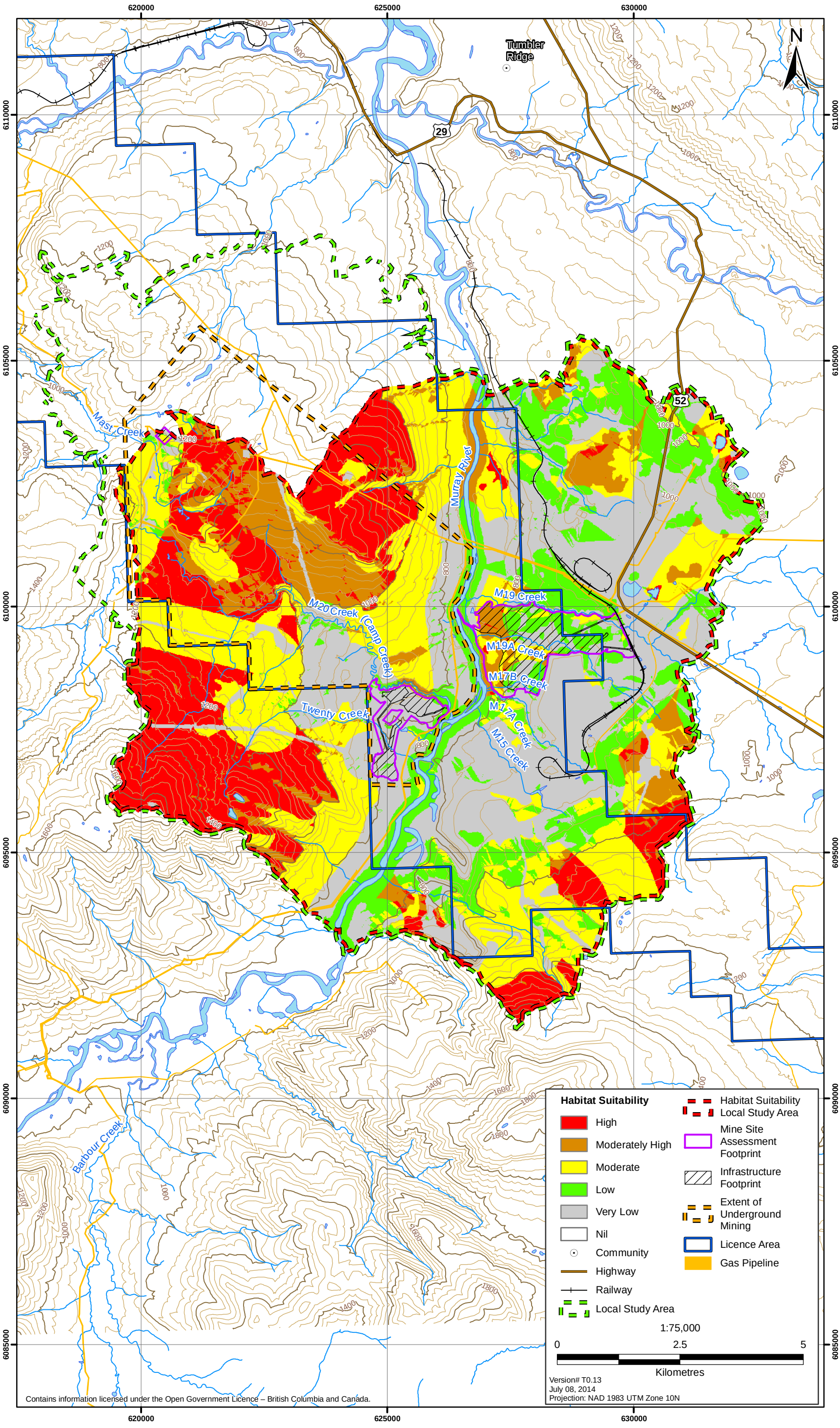


Figure 13.5-23
Grizzly Bear: Summer Living Habitat in the Regional Study Area

ERM

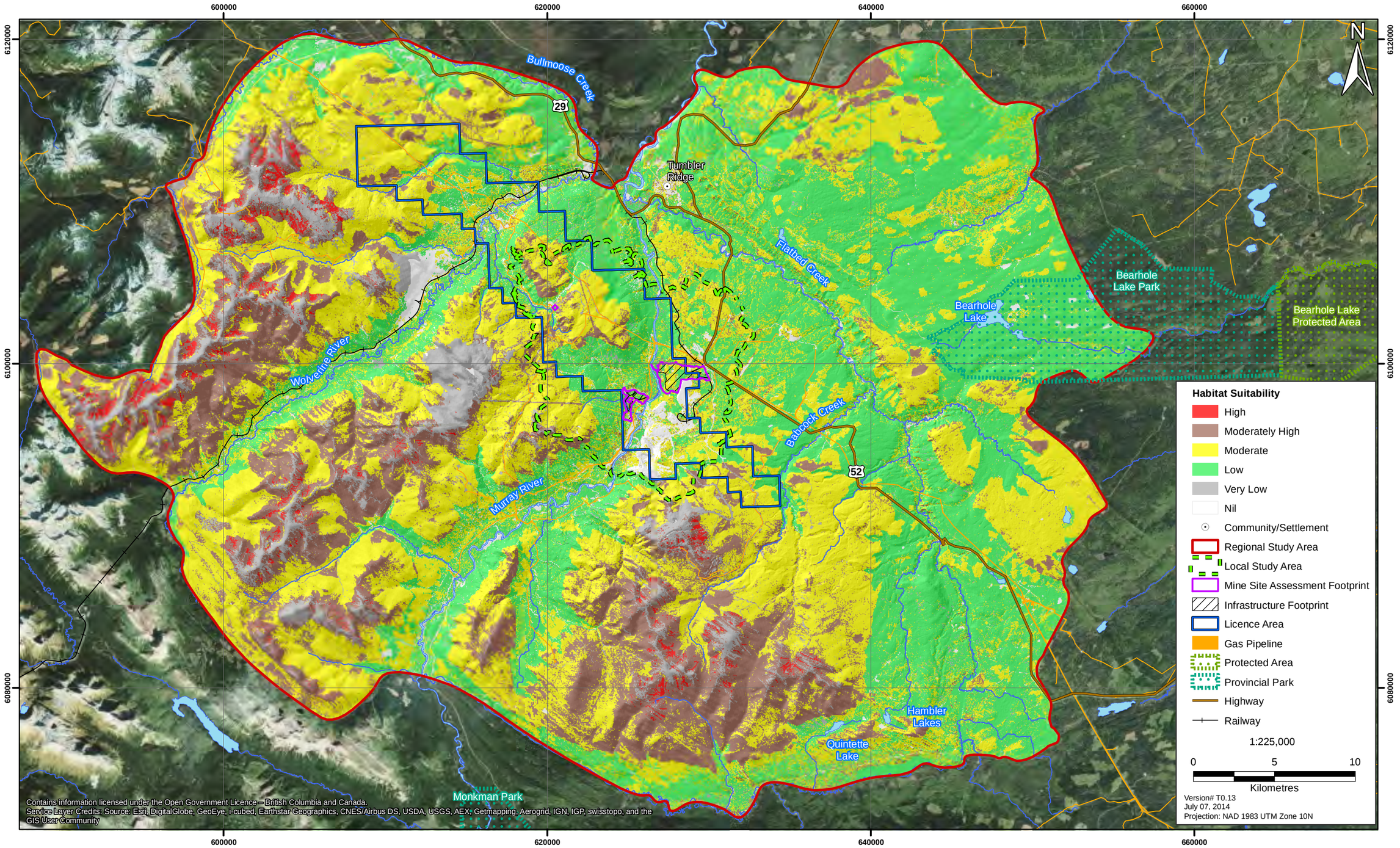


Figure 13.5-24

Grizzly Bear: Fall Living Habitat in the Local Study Area

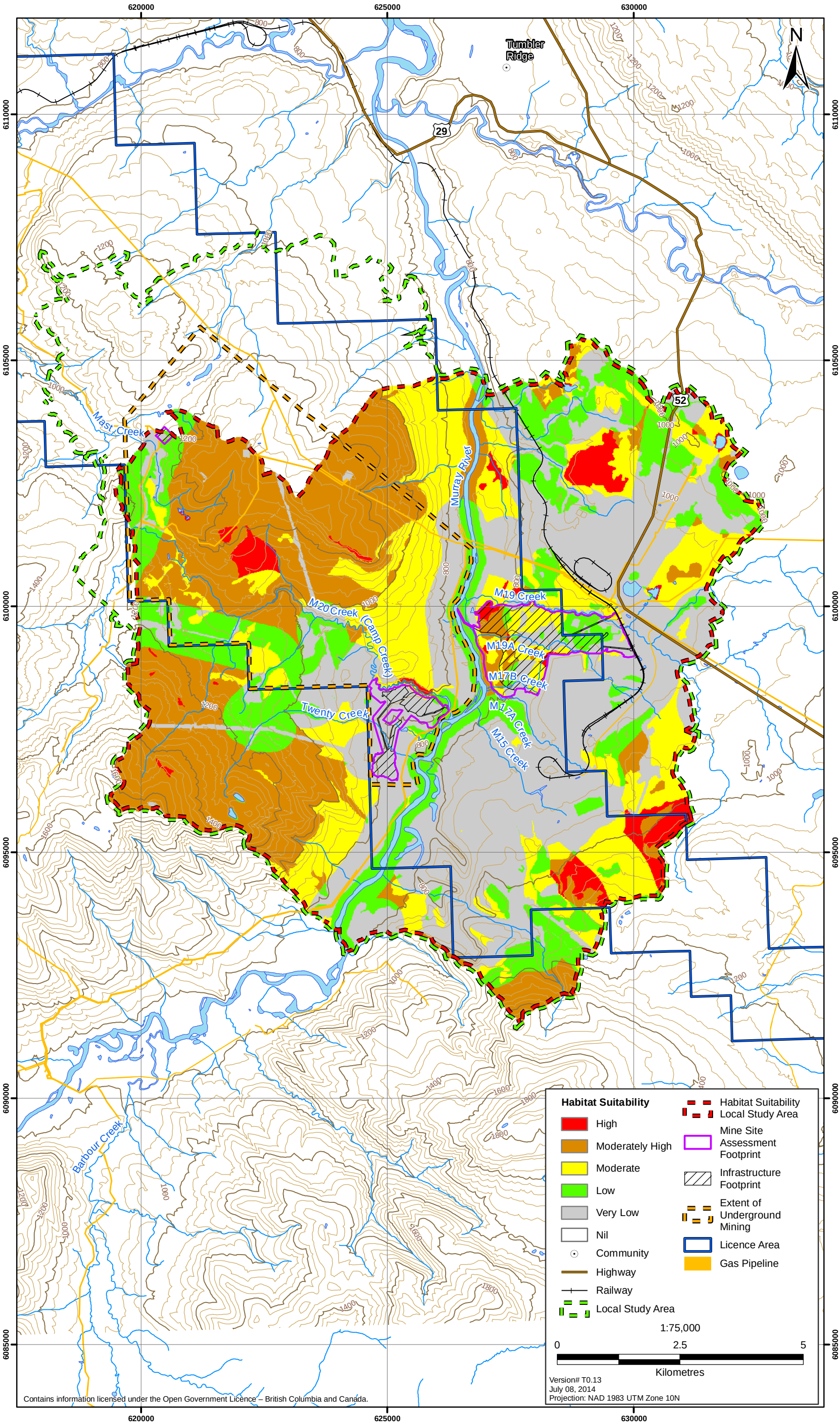
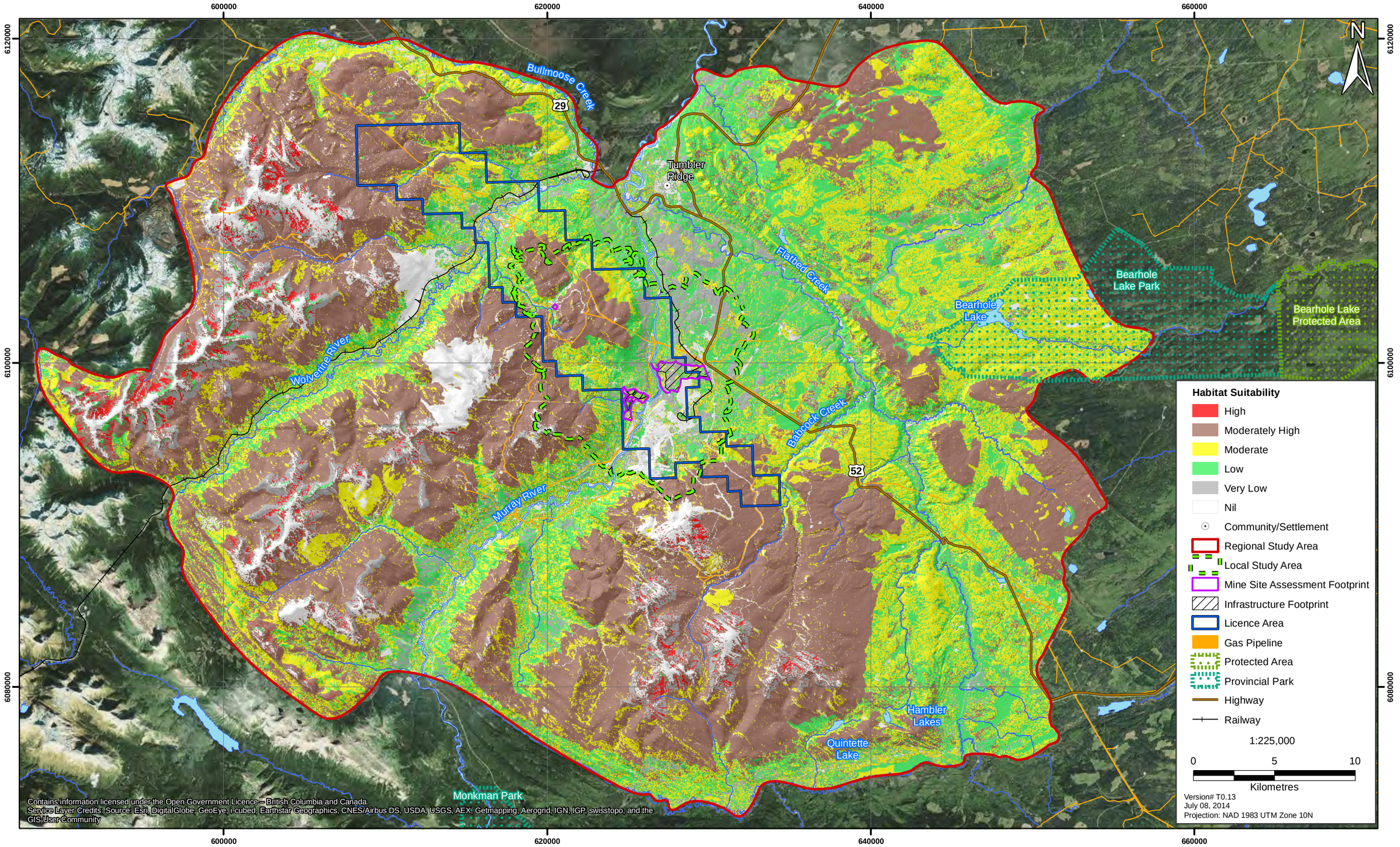


Figure 13.5-25
Grizzly Bear: Fall Living Habitat in the Regional Study Area



13.5.4.7 Furbearers

In BC, furbearers are a valuable economic and cultural resource, as they have been traditionally hunted or trapped for their fur by Aboriginals and non-Aboriginals. Furbearers are important socially and economically to hunters and trappers, especially to those of First Nations communities. Fur remains an important natural resource, contributing to the economy of local communities and government revenue through royalty payments.

Many furbearers are found in northeastern BC, such as beaver, bobcat, coyote, ermine, fisher, red fox, grizzly bear, lynx, marten, mink, muskrat, otter, red squirrel, weasel, wolf, and wolverine. Two species of furbearers that are expected to occur within the RSA are listed as species of conservation concern. The wolverine (*luscus* ssp.) and fisher are provincially blue-listed; the wolverine has also been assessed by COSEWIC as a species of Special Concern (BC CDC 2013) .

Winter snow track surveys were conducted on March 19 and 21 to 24, 2013. Ten transects were surveyed within the LSA (19.7 km). Survey effort focused on American marten, which is sensitive to human disturbances but is usually abundant enough to derive adequate sample sizes for inferences about habitat associations. Tracks of six furbearing species were detected; coyote, lynx, American marten, red squirrel, weasel spp., and wolf. Tracks of wolverine and fisher were not observed. American marten tracks were most often found in mature and young coniferous forest (1.23 and 0.49 tracks/km/day, respectively), but also in mature mixed wood forest (0.30 tracks/km/day). Tracks were not found in deciduous forest, young mixed wood forest, or non-forested areas. This is consistent with other studies that demonstrate habitat selection by American marten for forests that provide cover in winter, as well as structural features like downed wood that provide subnivean habitat for their small mammal prey (Sherburne and Bissonette 1992).

Fisher are a valuable BC furbearer and require management consideration because they are provincially blue-listed (BC CDC 2013). Fisher has also been assigned a high priority rating of 2 out of 6 for the Conservation Framework goal of conserving native species and ecosystems in BC. Habitat degradation has been noted as a key factor in the decline of fisher in BC largely because suitable denning trees and mature forest stands are frequently harvested (BC CDC 2013). Fisher are considered sensitive to forest harvest and they avoid large openings, including roads, due to predator exposure (BC ILMB 2009; Rescan 2013a).

The current population estimate for BC is approximately 1,400 to 3,700 individuals (Lofroth 2004). The Peace Region, particularly the southern Peace Region, is believed to be one of the most productive areas for fisher in BC (Lofroth 2004; Weir, Lofroth, and Phinney 2011). The abundance of fisher within the Peace Region was estimated at 548 to 1,300 adult individuals (Weir 2003) and estimated densities in the southern Peace Region of up to 20.6 fishers/1,000 km^2 (Lofroth 2004). The Murray River RSA overlaps the Hart Foothills Ecosection within the Central Canadian Rocky Mountains Ecoregion. Most of the region has been rated as *High* capability for fisher in provincial level mapping, but it borders areas of *Rare* to *Nil* habitat capability to the west and southwest as it transitions to the Rocky Mountains (Lofroth 2004).

Fisher habitat selection is based on habitat that provides all fisher foraging, resting, thermal and security cover, and reproductive habitat needs throughout the year.

Living Requisites

In general, fisher living habitat selection is positively associated with the following (Lofroth et al. 2011):

- Low to mid elevation forested habitat – BWBS, SBS, and lower elevation ESSF are the primary biogeoclimatic zones;
- Forested ecosystems (primarily coniferous, but also mixed coniferous/deciduous stands);
- Mature and old structural riparian habitats: structural stages 5 to 7 preferred and assumed to provide abundant resting sites, but structural stages 3 and 4 may also be used;
- Riparian and edge habitat typically provide abundant prey;
- Canopy closure between 30-60%;
- A productive understory, particularly with moderate values of high shrub cover (2–10 m tall);
- Abundant course woody debris (CWD), increasing number of pieces of CWD and larger pieces of CWD; and
- Warm aspects and gentle to moderate slopes.

Approximately half (50.2%) of living habitat for fisher within the LSA is considered suitable habitat; 15.4% High, 21.3% Moderately High, and 13.5% Moderate (Table 13.5-8 and Figure 13.5-26). These areas are located primarily in a central corridor along either side of the Murray River and on the north and central east sides of the LSA, with some Moderate rated habitat on the western side of the LSA (Figure 13.5-26). High rated living habitat for fisher occurs within both the eastern and Shaft and Decline Sites, as well as within the southeast portion of the extent of underground mining. The remainder of the LSA (49.5%) consists of non-suitable habitat that is rated as Low (10.5%) and Very Low (39.0%). Nil rated habitat is not present within the LSA.

Less than a third of the RSA (27.0%) is rated as suitable living habitat for fisher; this consists of habitat classified as Moderate (15.5%), Moderately High (8.2%), and High (3.3%; Table 13.5-8). Suitable living habitat for fisher of High and Moderately High rated habitat was located in low to mid elevation areas primarily along the major river tributaries of the Murray and Wolverine Rivers as well as Flatbed Creek (Figure 13.5-27). Some Moderate rated habitat was also present along the northern and eastern portions of the RSA. The remainder of the RSA consisted of non-suitable living habitat; 26.8% Low, 30.8% Very Low, and 15.5% Nil rated habitat (Table 13.5-8).

Birthing Requisites

Reproductive dens are a critical habitat feature for female fishers and are used during the rearing period in early spring for up to three months (Weir and Corbould 2008). These dens may be re-used in subsequent years by the same animal (Weir and Almuedo 2010). Fisher require the following for denning:

- Large-diameter deciduous trees with interior cavities (often trembling aspen, black cottonwood, and balsam poplar);
- Suitable denning trees are often found along valley bottoms and riparian areas in BEC zones such as BWBS and SBS;
- Most prevalent denning within structural stages 5 to 7; and
- Feeding, security/thermal, and resting habitats (same as for living period): selection of closed canopy forest with a diverse understory, CWD, gentle to moderate slopes, etc.

Figure 13.5-26

Fisher: Living Habitat in the Local Study Area

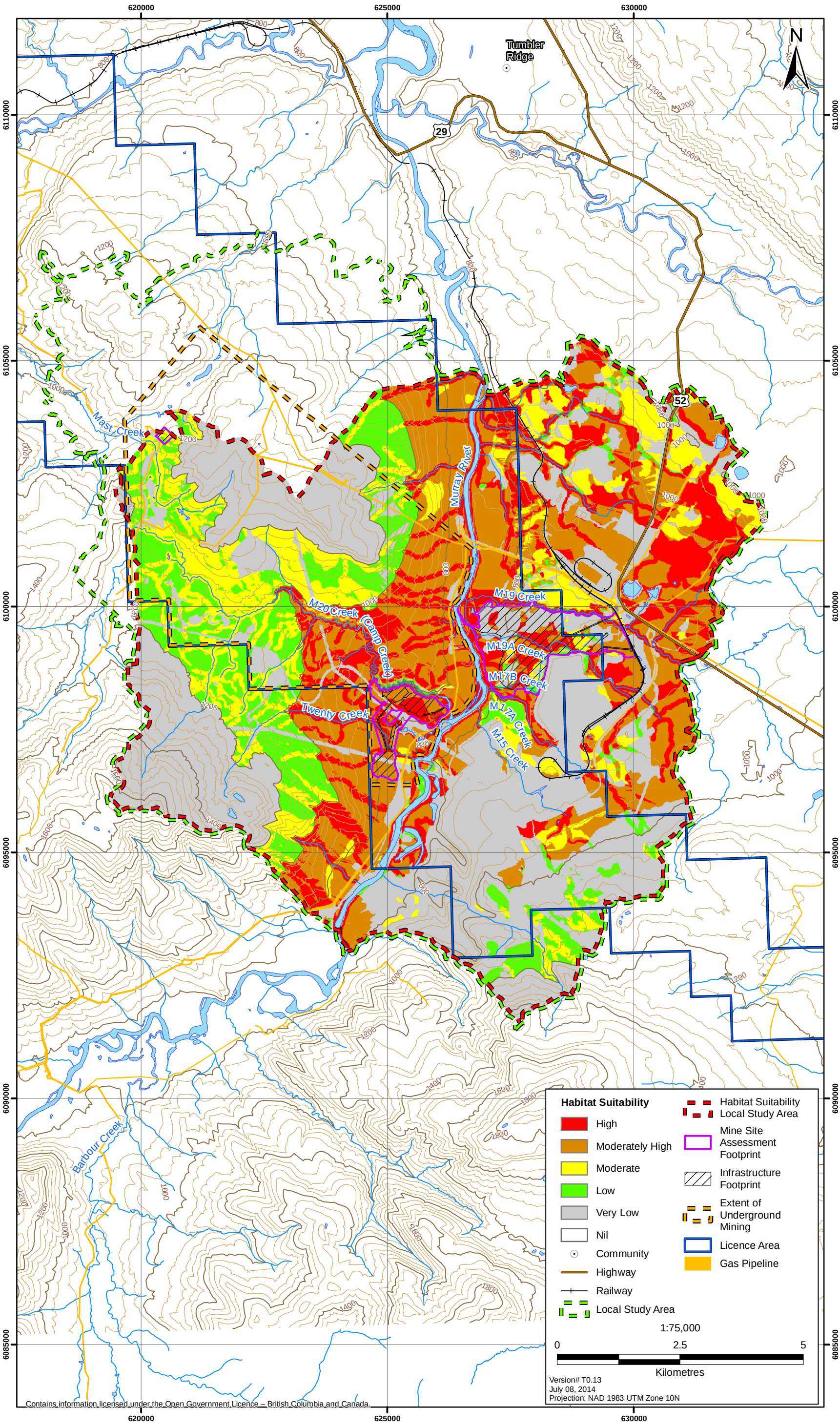


Figure 13.5-27
Fisher: Living Habitat in the Regional Study Area

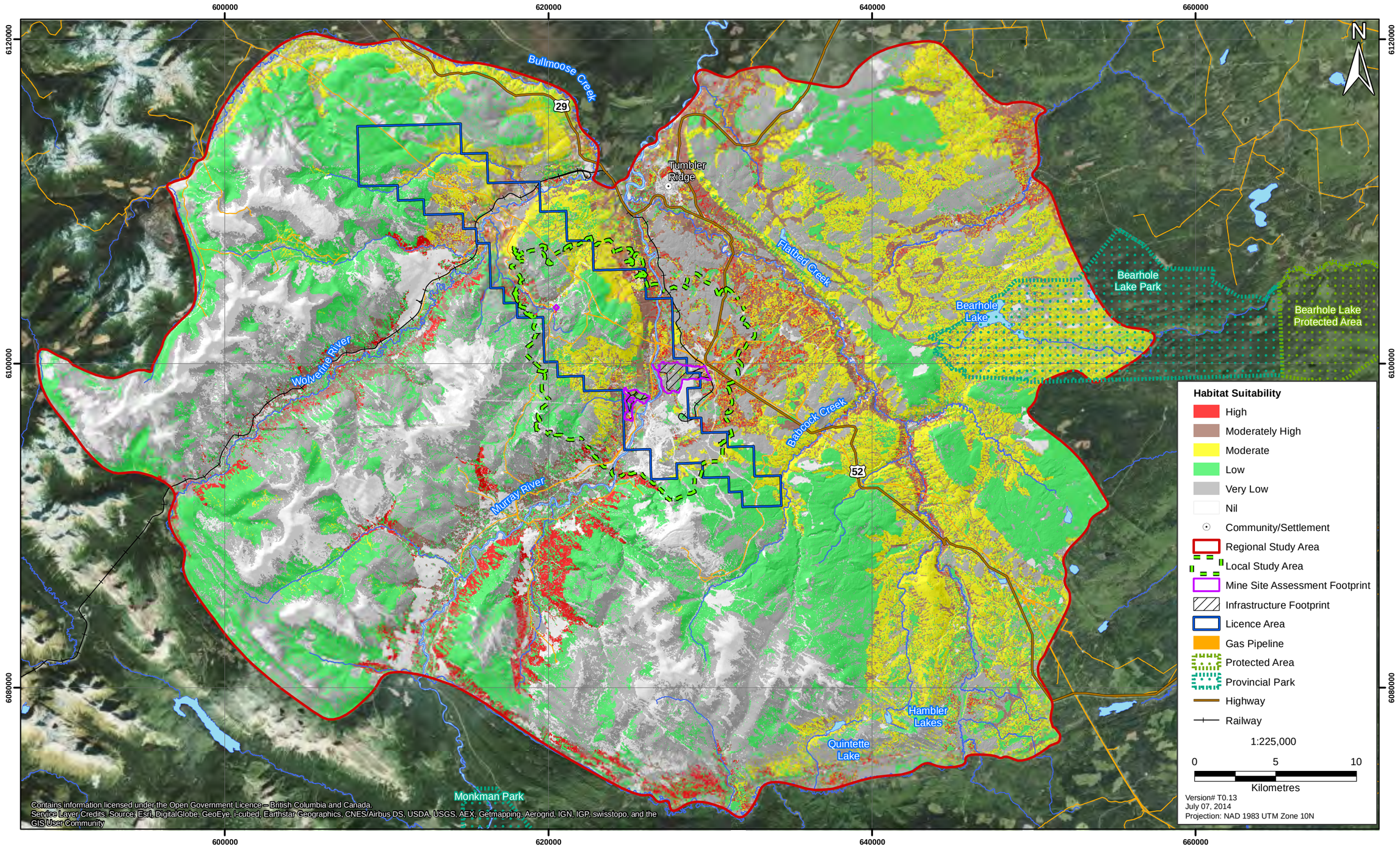


Table 13.5-8. Area and Proportion of Habitat within the Local Study Area and Regional Study Area for Fisher

Suitability Rating	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
	Area (ha)[1]	% of LSA[2]	Area (ha)[1, 3]	% of RSA[2]
Living				
High	1,862	15	7,462	3
Moderately High	2,579	21	18,605	8
Moderate	1,636	13	35,169	15
Low	1,275	10	60,964	27
Very Low	4,719	39	70,009	31
Nil	0	0	35,365	15
Unclassified	19	0	39	0.0
Birthing				
High	837	7	4,085	2
Moderately High	2,403	20	8,180	4
Moderate	1,124	9	15,127	7
Low	1,141	9	23,570	10
Very Low	2,808	23	20,765	9
Nil	3,759	31	155,847	68
Unclassified	17	0	39	0

[1] *LSA = 12,092 ha and RSA = 227,615.8 ha.*
[2] *For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100% (e.g., 99% or 101%).*
[3] *Includes area of LSA.*

The majority (63.7%) of the LSA is non-suitable birthing habitat for fisher; 9.4% Low), 23.2% Very Low), and 31.1% Nil) rated habitat (Table 13.5-8 and Figure 13.5-28). Suitable birthing habitat consisting of High (6.9%), Moderately High (19.9%), and Moderate (9.3%) rated habitat amounts to just over a third (36.1%) of the LSA. It is located primarily in a central corridor along either side of the Murray River near stream habitat, and on the north and central east sides of the LSA with a small amount of Moderate rated habitat on the west side of the LSA (Figure 13.5-28). Similar to suitable living habitat, High rated birthing habitat for fisher occurs within the eastern and Shaft and Decline Sites, as well as the southeastern portion of the extent of underground mining. This includes High rated habitat along the two tributaries of Murray River that are associated with the Coal Processing Site.

Similar to living habitat for fisher, a larger amount of the LSA is classified as non-suitable birthing habitat; 10.4% Low, 9.1% Very Low, and 68.5% Nil (68.5% of RSA) rated habitat (Table 13.5-8). A small portion of the RSA (12.0%) is rated as suitable birthing habitat; this consists of Moderate (6.6%), Moderately High (3.6%), and High (1.8%) rated habitat (Table 13.5-8). High and Moderately High rated suitable living habitat for fisher is located in low elevation areas primarily along the Murray River and in the area between the Mine Assessment Footprint and Flatbed Creek (Figure 13.5-29). Some suitable birthing habitat, primarily Moderate rated habitat, is located along the northeastern edge of the RSA and Murray River tributary (Figure 13.5-29).

13.5.4.8 Bats

Eight bat species are expected to occur within the RSA; big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), hoary bat (*L. cinereus*), little brown myotis (*Myotis lucifugus*), long-eared myotis (*M. evotis*), long-legged myotis (*M. volans*), northern myotis (*M. septentrionalis*), and silver-haired bat (*Lasionycteris noctivagans*). Two of these are species of conservation concern: northern myotis and little brown myotis (Nagorson and Brigham 1993).

The northern myotis is provincially blue-listed and has a COSEWIC status of Endangered (BC CDC 2013). It was given a high-priority rating (2 out of 6) for maintaining native species diversity under BC's Conservation Framework (BC MOE 2009; BC CDC 2013). The little brown myotis is provincially yellow-listed and has been federally designated as Endangered by COSEWIC (COSEWIC 2012b). Both the northern myotis and little brown myotis are species of concern due to a recent large-scale population declines from white-noise syndrome (COSEWIC 2012b). In addition to these two species, the silver-haired bat (*Lasionycteris noctivagans*) has been identified by BC MFLNRO as important in the Skeena Region because of concerns with maintaining maternal roosts in tree cavities (BCTS 2008; Rescan 2010). It is provincially yellow-listed and has been given a higher priority rating (2 out of 6) for preventing species and ecosystems from becoming at risk under BC's Conservation Framework (BC MOE 2009; BC CDC 2013).

Surveys were conducted from July 18 to 20, 2010 between dusk and dawn at three survey sites within the RSA (Figure 13.5-30). Bats use a combination of habitat types during the year, primarily old-growth conifer forests with snags for roosting and riparian areas for foraging (D. W. Nagorsen and Brigham 1995; Ormsbee 1996; Sasse and Pekins 1996; Grindal, Morissette, and Brigham 1999; Vonhof and Wilkinson 1999). As such, survey sites were near mature forests and located in low elevation areas adjacent to riparian or wetland areas where flying insects are easily accessible and abundant. Two of the survey sites are located in the LSA (sites 1 and 2); site 1 is just outside of the Shaft and Decline Site. Bats were detected at all survey sites (Appendix 13-A). At least two species of myotis were detected, one of which may be the little brown myotis. The echolocation calls at site 1, near the Shaft and Decline Site, were within the range exhibited by "40 khz Myotis", including the commonly occurring little brown myotis. Similarly, sonograms recorded at site 2, within the LSA, were typical of *Myotis spp*. Call characteristics of either a hoary or silver-haired species of bat, in addition to sonograms typical of *Myotis spp*., were detected at site 3 located within the RSA adjacent to Flatbed Creek. The northern myotis and the long-eared myotis were not detected as both of these species produce search phase calls that usually exceed 100 kHz, which is greater than the echolocation calls recorded during the surveys.

13.5.4.9 Raptors

Raptors (i.e., eagles, hawks, falcons, and owls) are considered ideal indicator species of ecosystem health because they are top predators, have large home range sizes, and use a variety of habitats throughout the year. These life history characteristics make them sensitive to environmental disturbances (Elliott et al. 1997; Steenhof et al. 1999). Declines in raptor populations have been attributed to human activities (Craighead and Mindell 1981). All raptors and their nests are legally protected under the BC *Wildlife Act* (1996b), including inactive stick nests of bald eagles, golden eagles, peregrine falcons, gyrfalcons, and osprey. Documenting nest locations and measuring the size of the local raptor population can assist in monitoring impacts associated with development, and the development of effective mitigation strategies.

Figure 13.5-28

Fisher: Birthing Habitat in the Local Study Area

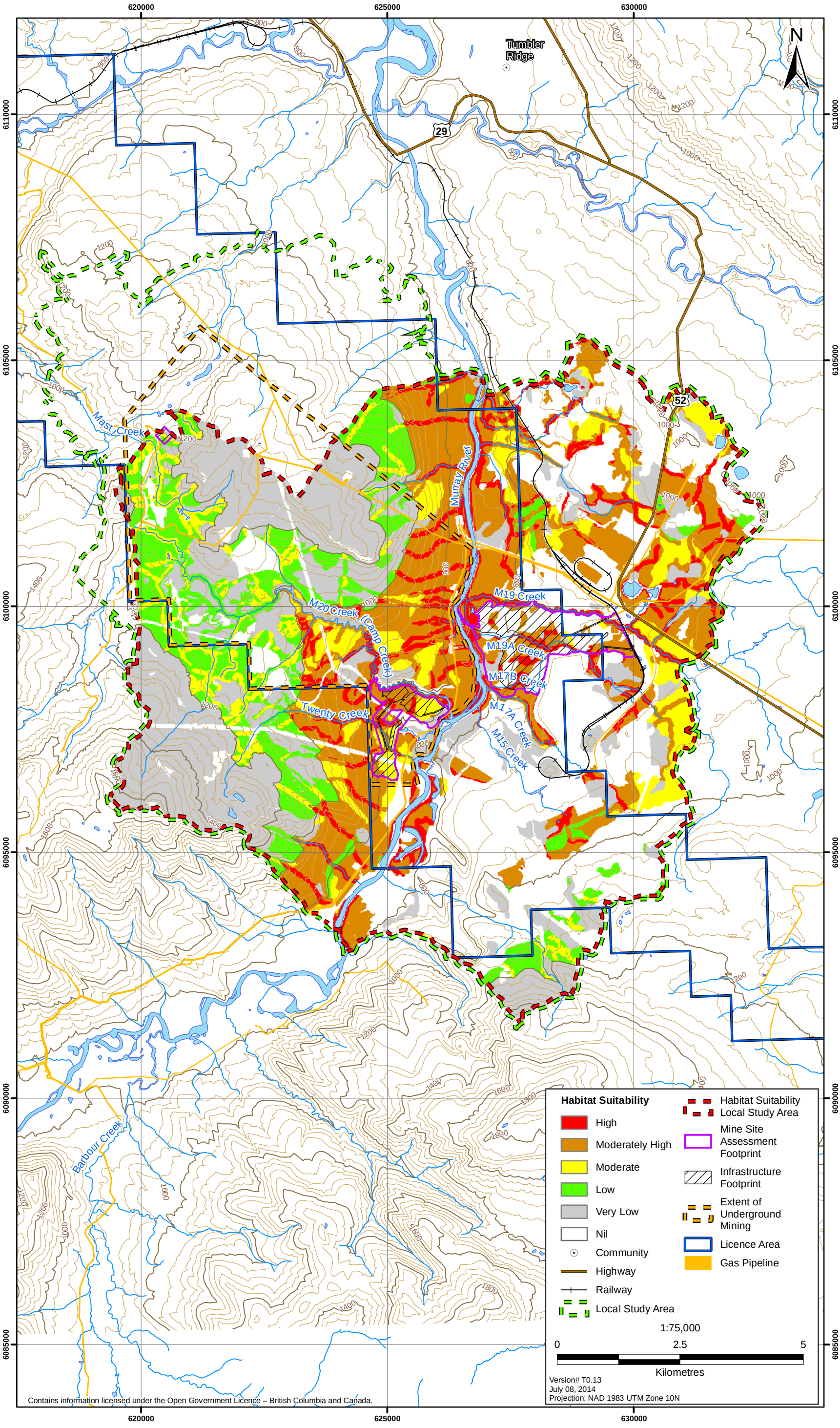


Figure 13.5-29
Fisher: Birthing Habitat in the Regional Study Area

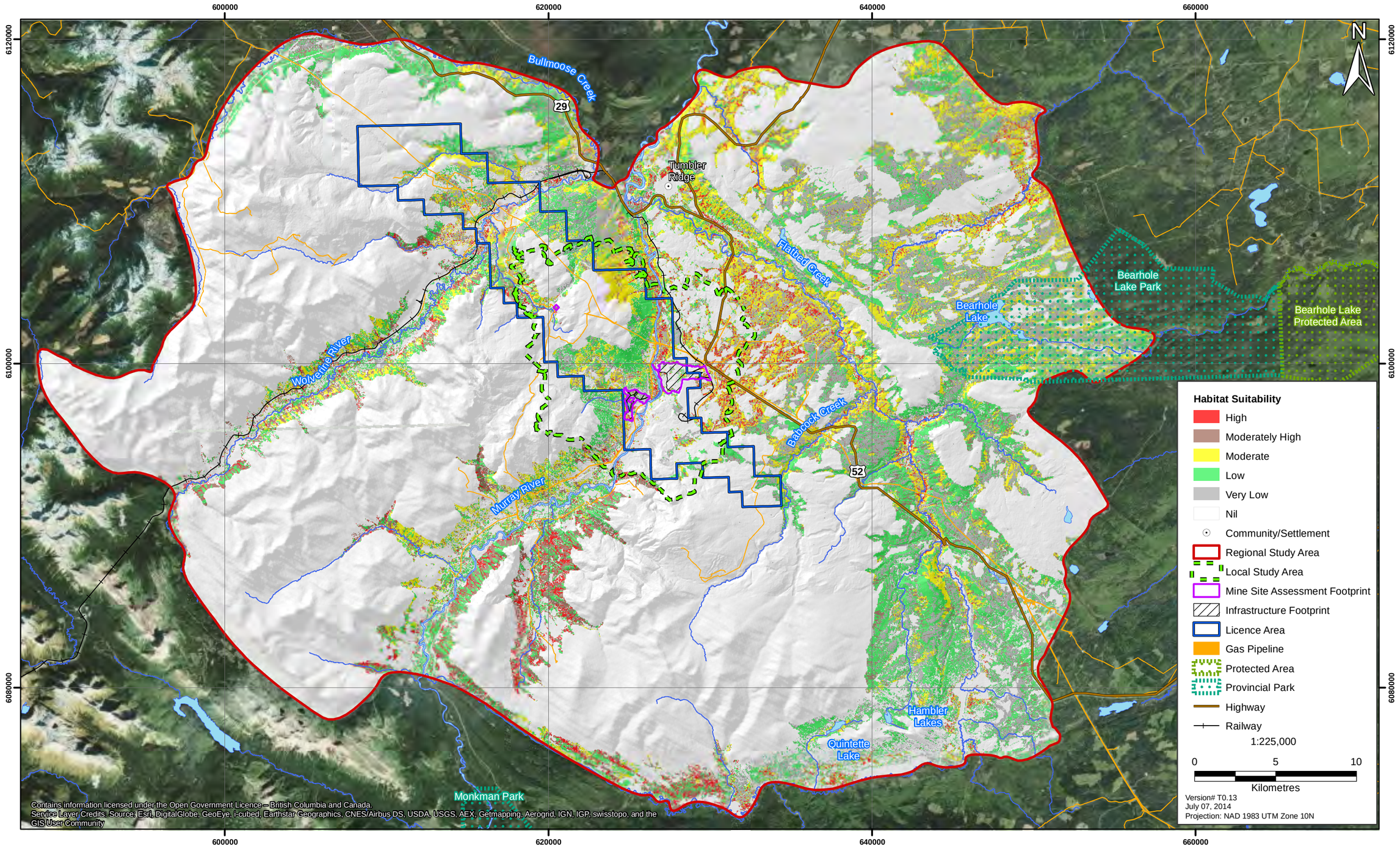
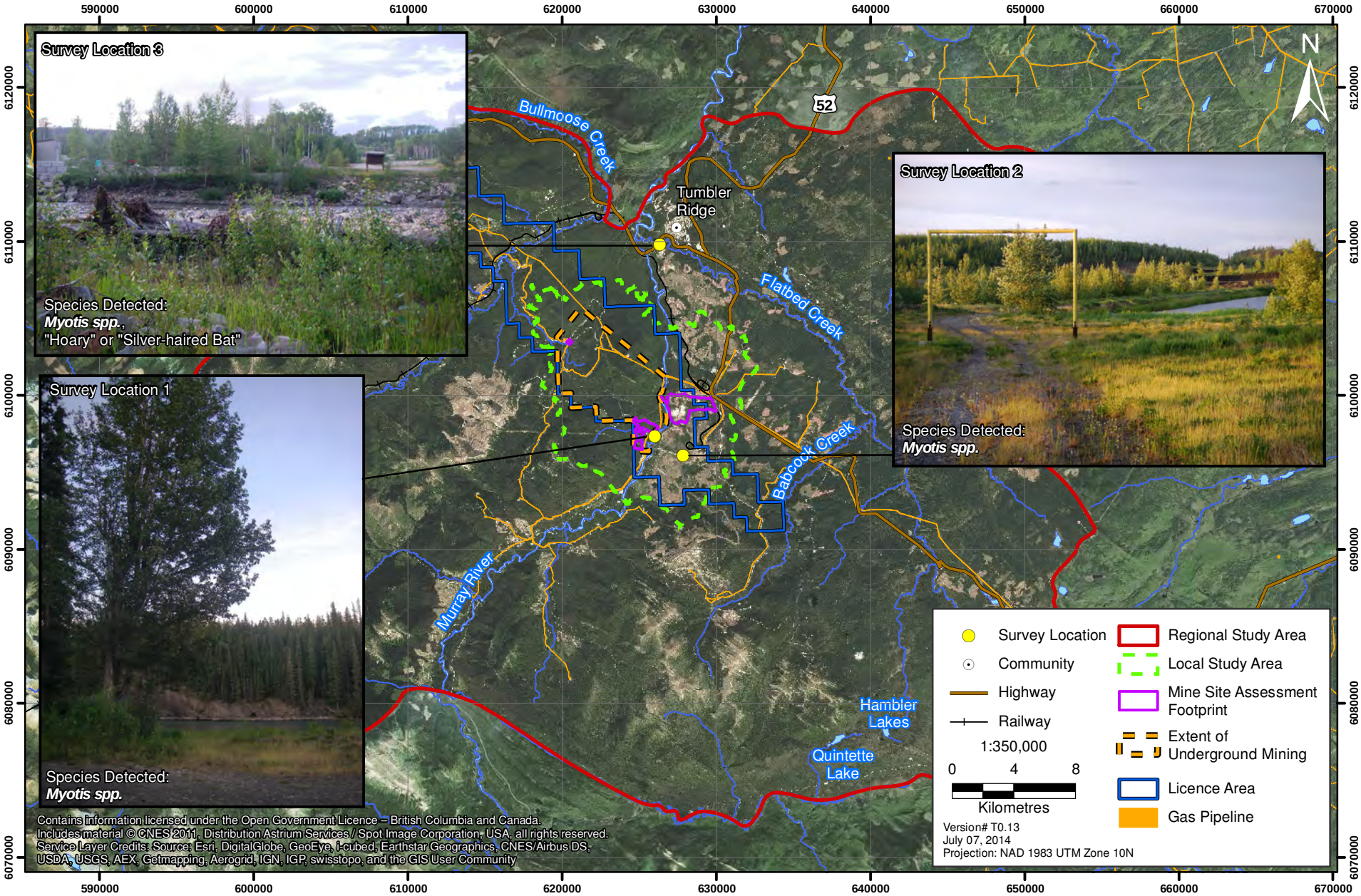


Figure 13.5-30
Bat Survey Locations and Species Detected, 2010



Four raptor species of conservation concern are expected to occur in the region; broad-winged hawk, northern goshawk, peregrine falcon and short-eared owl. Broad-winged hawk is provincially blue-listed (BC CDC 2013). This species prefers to nest along edges of broadleaf or mixed forests, or in forests near wetlands. The *anatum* subspecies of the peregrine falcon (*Falco peregrinus*) is federally listed as Special Concern under Schedule 1 of SARA, and appears on the provincial Red list of endangered and threatened species (BC CDC 2013). It nests along rock cliffs overlooking lakes or rivers. Although the northern goshawk *atricapillus sub-species* (*Accipiter gentilis atricapillus*) is not federally or provincially listed as at risk, it is considered a species of concern in the Peace region (BC MOE 2005a). The northern goshawk is a year round resident and confirmed breeder in the Peace region. Northern goshawks typically nest in old-growth forests with high canopy closure (60-95 percent) and sparse groundcover. The short-eared owl is provincially blue-listed and is listed as a Special Concern under Schedule 1 of SARA. They are also an Identified Wildlife Element under the Government of BC IWMS, and therefore require special conservation measures within the province (BC MWLAP 2004a, 2004e). Short-eared owls build nests on the ground in open areas with low vegetation.

Stand watch surveys were conducted over a three day period (June 4 to 6, 2010) in order to document the presence of tree and cliff nesting raptors, with particular focus on raptors within the LSA (Appendix 13-A). A total of 35 raptors or raptor sign belonging to 10 species were observed during 2010 wildlife baseline studies (Table 13.5-9 and Figure 13.5-31. The most frequently observed raptor species were osprey (*Pandion haliaetus*) and red-tailed hawk (*Buteo jamaicensis*). Within the RSA, ten additional raptor species have been observed during baseline studies for other developments; boreal owl (*Aegolius funereus*), broad-winged hawk (*Buteo platypterus*), Cooper 's hawk (*Accipiter cooperii*), great gray owl (*Strix nebulosa*), great horned owl (*Bubo virginianus*), northern hawk owl (*Surnia ulula*), northern pygmy-owl (*Glaucidium gnoma*), northern saw-whet owl (*Aegolius acadicus*), rough-legged hawk (*Buteo lagopus*), and sharp-shinned hawk (*Accipiter striatus;* Finevera EA Application; Roman Coal Mine EA application).

Table 13.5-9. Number of Individual Raptor Species, Nests, and Sign Observed in the Regional Study Area during 2010

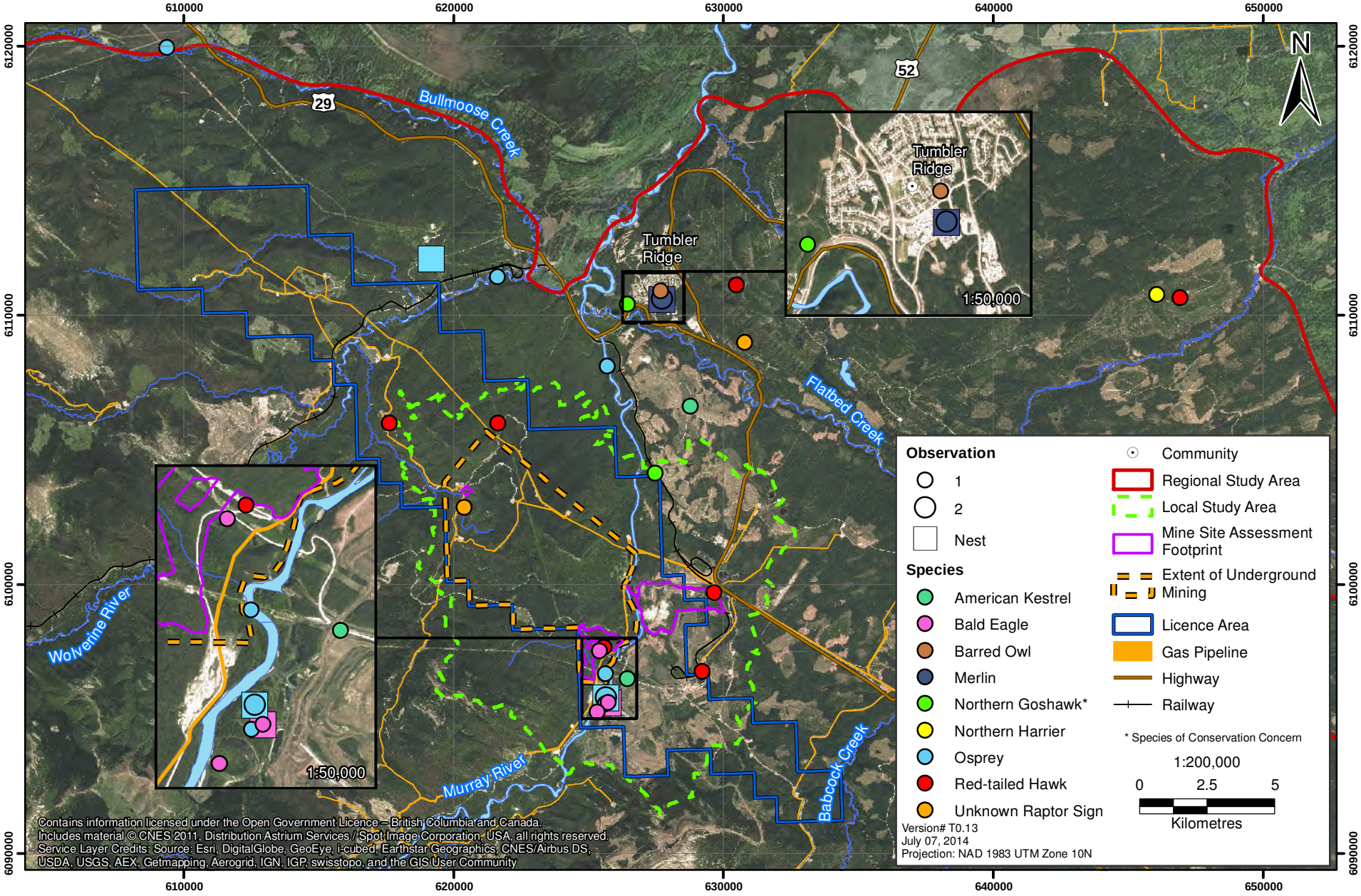
Species	Scientific Name	No. Raptors Observed during Surveys	No. Raptors and/or Sign* Observed Incidentally	No. Nest	Total
American kestrel	*Falco sparverius*	0	2	0	2
Bald eagle	*Haliaeetus leucocephalus*	0	3	1	4
Barred owl	*Strix varia*	0	1	0	1
Golden eagle	*Aquila chrysaetos*	0	3	0	3
Merlin	*Falco columbarius*	0	2	1	3
Northern goshawk	*Accipiter gentilis*	0	2	0	2
Northern harrier	*Circus cyaneus*	0	1	0	1
Osprey	*Pandion haliaetus*	0	7	2	9
Peregrine falcon	*Falco peregrinus*	0	1	0	1
Red-tailed hawk	*Buteo jamaicensis*	1	6	0	7
Unknown raptor[1]		0	2*	0	2
Total		1	30	4	35

[1] *Unknown raptor observations were of plucking stations (i.e., structure used by raptors to pluck feathers from prey)*

* *Sign observed*

Figure 13.5-31

Raptor and Raptor Nests Observed During Stand Watch Surveys and Wildlife Baseline Surveys, 2010



Breeding activity was also documented for three species through observations of nest sites or nest building (material carry/pair); bald eagle (*Falco sparverius*), merlin (*Falco columbarius*), and osprey. One bald eagle and two osprey nests were observed; in addition, a pair of merlin was also observed building a nest in a patch of trees near Tumbler Ridge. No nestlings were observed at any of the nest sites. An osprey nest and bald eagle nest were observed in close proximity to one another within the LSA, approximately 500 m from the Shaft and Decline Site on the east side of Murray River (Figure 13.5-31).

The two species of conservation concern expected to occur in the RSA were confirmed to be present during baseline surveys; peregrine falcon and northern goshawk. The peregrine falcon is a seasonal resident in the Peace region of BC; one peregrine falcon was observed in July 2010, potentially migrating through the area, but there have been no recent breeding records (B.C. Conservation Data Centre 2012). Northern goshawks were observed on two occasions in June 2010 in the BWBSmw BEC zone. One sighting was within the northern boundary of the LSA and the other was within the RSA near Tumbler Ridge. The LSA is known to support high-quality northern goshawk habitat. Studies for the Herman Mine identified high-quality habitat for northern goshawk along the Murray River, the Wolverine River, and lower Mast Creek (Western Canadian Coal 2007).

Two other species of conservation concern have been recorded in the Project area: broad-winged hawk and rough-legged hawk. Both of these species were recorded flying over habitat within the LSA during baseline studies for the Tumbler Ridge Wind Energy Project. Broad-winged hawk are a rare summer visitor and potential breeder in the Peace Region (Campbell et al. 1990), whereas rough-legged hawk are a seasonal migrant.

13.5.4.10 Songbirds

Songbirds represent an abundant and diverse group that can be surveyed with relative ease (Hutto 1998). Songbirds and their nests are protected by the federal *Migratory Birds Convention Act* (1994a) and the provincial BC *Wildlife Act* (1996b). Additional conservation measures may be recommended for those species identified by COSEWIC, and are required for those listed under the federal *Species at Risk Act* (SARA (2002)).

A total of 20 transects were surveyed for songbirds from June 3 to 9, 2014; each contained 5 point count stations, totalling 100 point counts. All transects were within the RSA; five transects were located in the LSA (25 point count stations). Throughout 2010 baseline surveys, a total of 72 songbird species (1,048 individual birds) were identified through surveys and incidental observations; of this, 60 species (685 individual birds) were observed during point count surveys (Table 13.5-10; Appendix 13-A). The five most abundant species were yellow-rumped warbler (*Dendroica coronata*), Swainson's thrush (*Catharus ustulatus*), warbling vireo (*Vireo gilvus*), Wilson's warbler (*Wilsonia pusilla*), and white-throated sparrow (*Zonotrichia albicollis*).

The highest abundance of species was recorded on three transects within the RSA (MR20, MR14, and MR12) where 45 or more individual birds were observed; MR20 is just west of Tumbler Ridge while MR14 and MR12 are approximately 3 km and 13 km east of Tumbler Ridge, respectively (Appendix 13-A). The highest species richness and most diverse species communities were observed along transects MR20, MR04, and MR14, where 20 or more species were detected with values greater than 2.7 for Shannon's *H* (Appendix 13A); MR04 is just east of the Shaft and Decline Site at Murray River

Bridge. All but one of the remaining transects had Shannon's *H* diversity values greater than 2.0. The equitability values of all sites were between 0.86 and 0.96, indicating that the majority of transects had relatively equal abundances of birds across detected species (i.e., one or two species did not make up most of the birds seen; rather the species were equally represented). No statistical differences in species diversity and equitability were detected among habitat types, however, the data suggest a pattern of lower species diversity in conifer forests compared to the other habitat types (Appendix 13-A).

Table 13.5-10. Songbird Species Observed during Point Count Surveys, 2010

Common Name	Scientific Name	Number Observed	Incidental Observation	Total Observed	Evidence of Breeding
Alder flycatcher	*Empidonax alnorum*	2	3	5	-
American dipper	*Cinclus mexicanus*	0	3	3	-
American redstart	*Setophaga ruticilla*	6	1	7	-
American robin	*Turdus migratorius*	30	14	44	Y
American three-toed woodpecker	*Picoides dorsalis*	5	1	6	-
Barn swallow	*Hirundo rustica*	0	9	9	Y
Belted kingfisher	*Megaceryle alcyon*	1	3	4	-
Black-capped chickadee	*Poecile atricapillus*	2	1	3	-
Blackpoll warbler	*Dendroica striata*	0	1	1	-
Black-throated green warbler	*Dendroica virens*	3	0	3	-
Blue-headed vireo	*Vireo solitarius*	1	0	1	-
Boreal chickadee	*Poecile hudsonica*	1	1	2	-
Brown creeper	*Certhia americana*	0	1	1	-
Brown-headed cowbird	*Molothrus ater*	9	5	14	-
Cassin's vireo	*Vireo cassinii*	4	1	5	-
Chipping sparrow	*Spizella passerina*	35	7	42	Y
Cliff swallow	*Petrochelidon pyrrhonota*	0	106	106	Y
Common raven	*Corvus corax*	7	11	18	Y
Common yellowthroat	*Geothlypis trichas*	4	0	4	-
Dark-eyed junco	*Junco hyemalis*	37	7	44	Y
Downy woodpecker	*Picoides pubescens*	1	0	1	-
European starling	*Sturnus vulgaris*	2	2	4	-
Fox sparrow	*Passerella iliaca*	3	0	3	-
Golden-crowned kinglet	*Regulus satrapa*	34	7	41	-
Golden-crowned sparrow	*Zonotrichia atricapilla*	1	0	1	-
Gray jay	*Perisoreus canadensis*	23	6	29	-
Hairy woodpecker	*Picoides villosus*	8	0	8	-
Hammond's flycatcher	*Empidonax hammondii*	2	0	2	-
Hermit thrush	*Catharus guttatus*	14	6	20	-
Least flycatcher	*Empidonax minimus*	11	4	15	-

(continued)

Table 13.5-10. Songbird Species Observed during Point Count Surveys, 2010 (continued)

Common Name	Scientific Name	Number Observed	Incidental Observation	Total Observed	Evidence of Breeding
Lincoln's sparrow	*Melospiza lincolnii*	12	3	15	-
MacGillivray's warbler	*Oporornis tolmiei*	1	1	2	-
Magnolia warbler	*Dendroica magnolia*	3	0	3	-
Mountain chickadee	*Poecile gambeli*	1	1	2	-
Northern flicker	*Colaptes auratus*	5	0	5	-
Northern waterthrush	*Seiurus noveboracensis*	3	0	3	-
Olive-sided flycatcher	*Contopus cooperi*	1	2	3	-
Orange-crowned warbler	*Vermivora celata*	23	6	29	-
Ovenbird	*Seiurus aurocapilla*	7	0	7	-
Pileated woodpecker	*Dryocopus pileatus*	0	1	1	-
Pine grosbeak	*Pinicola enucleator*	4	0	4	-
Pine siskin	*Carduelis pinus*	20	2	22	-
Red crossbill	*Loxia curvirostra*	0	3	3	-
Red-breasted nuthatch	*Sitta canadensis*	13	8	21	-
Red-eyed vireo	*Vireo olivaceus*	1	0	1	-
Red-winged blackbird	*Agelaius phoeniceus*	9	5	14	-
Rose-breasted grosbeak	*Pheucticus ludovicianus*	3	0	3	-
Ruby-crowned kinglet	*Regulus calendula*	18	5	23	-
Ruffed grouse	*Bonasa umbellus*	4	2	6	-
Rufous hummingbird	*Selasphorus rufus*	1	1	2	-
Savannah sparrow	*Passerculus sandwichensis*	2	0	2	-
Spruce grouse	*Falcipennis canadensis*	0	1	1	-
Swainson's thrush	*Catharus ustulatus*	46	28	74	-
Tennessee warbler	*Vermivora peregrina*	8	2	10	-
Townsend's solitaire	*Myadestes townsendi*	1	0	1	-
Townsend's warbler	*Dendroica townsendi*	4	0	4	-
Tree swallow	*Tachycineta bicolor*	2	0	2	Y
Varied thrush	*Ixoreus naevius*	26	22	48	-
Violet-green swallow	*Tachycineta thalassina*	0	1	1	-
Warbling vireo	*Vireo gilvus*	50	8	58	Y
Western tanager	*Piranga ludoviciana*	3	0	3	-
Western wood-pewee	*Contopus sordidulus*	5	0	5	-
White-crowned sparrow	*Zonotrichia leucophrys*	0	1	1	-
White-throated sparrow	*Zonotrichia albicollis*	28	21	49	-
White-winged crossbill	*Loxia leucoptera*	0	4	4	-
Willow flycatcher	*Empidonax traillii*	2	3	5	-

(continued)

Table 13.5-10. Songbird Species Observed during Point Count Surveys, 2010 (completed)

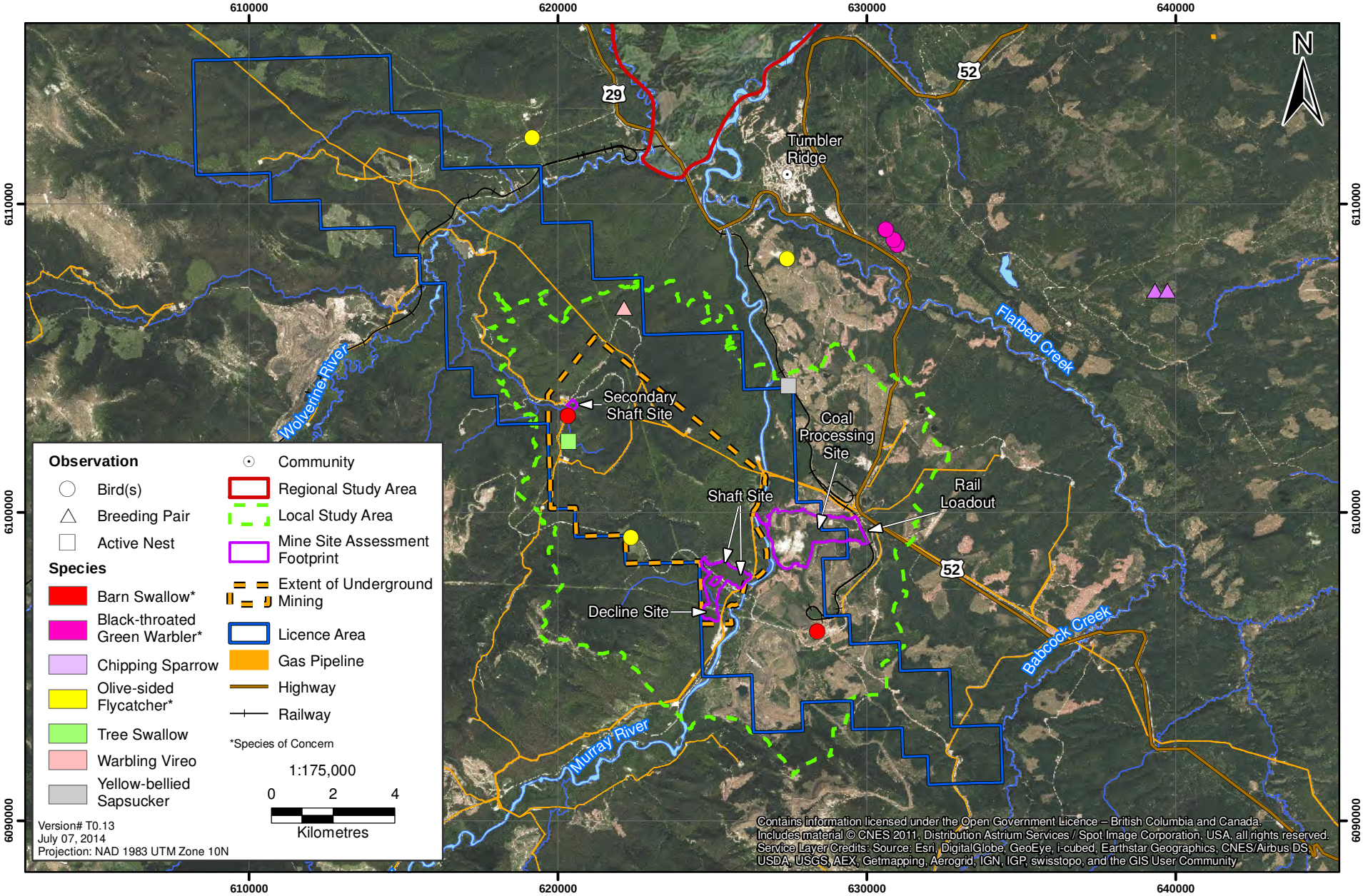
Common Name	Scientific Name	Number Observed	Incidental Observation	Total Observed	Evidence of Breeding
Wilson's warbler	*Wilsonia pusilla*	48	6	54	-
Winter wren	*Troglodytes troglodytes*	0	1	1	-
Yellow warbler	*Dendroica petechia*	22	5	27	-
Yellow-bellied flycatcher	*Empidonax flaviventris*	1	0	1	-
Yellow-bellied sapsucker	*Sphyrapicus varius*	5	2	7	Y
Yellow-rumped warbler	*Dendroica coronata*	57	18	75	-
Total		**685**	**363**	**1,048**	**-**

Three species detected during point counts are of conservation concern: olive-sided flycatcher, barn swallow, and black-throated green warbler (Figure 13.5-32). All three species are provincially blue-listed (BC CDC 2013). The barn swallow is considered Threatened by COSEWIC, and the olive-sided flycatcher is listed as Threatened on Schedule 1 of SARA, and Near Threatened on the IUCN Red List (BC CDC 2013). Black-throated green warblers are an Identified Wildlife Element under the Government of BC IWMS, and therefore require special conservation measures within the province (BC MWLAP 2004a, 2004e). Both barn swallow and olive-sided flycatcher were detected within the LSA, whereas black-throated green warblers were only detected outside the LSA. Six barn swallows were detected in a breeding colony in the southern portion of the LSA under existing mine infrastructure and three individuals were incidentally observed in later July near the secondary shaft site within the LSA. One olive-sided flycatcher was detected within the LSA near the underground mining extent boundary and two other individuals were detected within the north central portion of the RSA. Three observations of black-throated green warbler also occurred in the north central portion of the RSA, along an old-growth transect north of Flatbed Creek. Other species of conservation concern (bay-breasted warbler [*Setophaga castanea*], Canada warbler [*Cardellina canadensis*], Cape May warbler [*Setophaga tigrina*], Connecticut warbler [*Oporornis agilis*], and rusty blackbird [*Euphagus carolinus*]) were detected during a roadside survey nearby (Westcam 2008) and also likely breed in the Murray River area.

Evidence of breeding (copulation, nest, eggs, young, territorial behaviour) was recorded for nine species in 2010; American robin, barn swallow, chipping sparrow, cliff swallow, common raven, dark-eyed junco, tree swallow, warbling vireos, and yellow-bellied sapsucker (Table 13.5-10, Figure 13.5-32, and Appendix 13-A). Within the LSA, evidence of breeding was recorded for barn swallow, cliff swallow, tree swallow, and yellow-bellied sapsucker. A habitat suitability model was also created for a species of conservation concern, the black-throated green warbler. Mapping of the Habitat Suitability LSA was performed using TEM; outside of this area, PEM was used. Therefore, habitat suitability figures of the LSA and RSA will include both TEM and PEM mapping. Habitat was rated in four categories: High, Moderate, Low, and Nil. Suitable habitat includes High and Moderate categories while non-suitable habitat includes Low and Nil categories. A very small amount (0.1%) of the LSA was unclassified due to technical logistics with the data, but likely represents a similar proportional distribution of habitat quality within the LSA.

Figure 13.5-32

Songbird Breeding Observations and Species of Conservation Concern, 2010



Black-throated Green Warbler

The black-throated green warbler has a breeding range which extends over North America and is generally abundant (Morse and Poole 2005). Thus, the black-throated green warbler is not a federally-listed species and is globally assessed as widespread, abundant and secure (B.C. Conservation Data Centre 2011). However, the black-throated green warbler is blue-listed in BC due to its restricted distribution and relatively small population within the province (Cooper, Enns, and Shepard 1997). It occurs primarily in the Peace Lowland of the Boreal Plains ecoprovince (BC MWLAP 2004c; Morse and Poole 2005) and has also been found within the Taiga Plains and Sub-Boreal Interior ecoprovinces (BC MWLAP 2004c).

No observations of confirmed breeding have been documented within the RSA. However, BC Breeding Bird Atlas (BCBBA) has six possible observation records of breeding within or near the RSA and have confirmed breeding records for this species north of the RSA, near Chetwynd, Dokie Ridge, Charlie Lake, and near Fort St. John (British Columbia Breeding Bird Atlas (BCBBA) 2008).

If breeding is present within the RSA, the black-throated green warbler is likely restricted to mixed wood forest of low elevation slopes and valley bottoms within the BWBSmw, BWBSwk1, and SBSwk2 (Saxena and Bilyk 2000). Breeding habitat for black-throated green warbler typically consists of:

- Mature to old-growth mixedwood forests, such as white spruce with trembling aspen and/or balsam poplar in structural stages 6 and 7 (MWLAP 2004b);
- Transitional areas of coniferous and deciduous forest (middle to late seral-stage);
- Primarily deciduous forest may be used if there are a few mature or veteran conifers, with preference for old-growth aspen (>120 years);
- Stands with mesic moisture regime that are wetter tend to be used more often (Cooper, Enns, and Shepard 1997);
- Typical understory plant species include: alder, rose, baneberry, twinberry, highbush-cranberry, bunchberry, fireweed, coltsfoot, grass, kinnikinnick, mosses, peavine, and American vetch (Cooper, Enns, and Shepard 1997) of low shrub cover and high herbaceous cover; and
- Slopes are generally shallow and less than 15 degrees.

The majority (67.7%) of breeding habitat for black-throated green warbler within the LSA is classified as non-suitable habitat; 25.6% Low and 42.1% Nil (Table 13.5-11 and Figure 13.5-33). Suitable breeding habitat consists of High (7.5%) and Moderate (24.7%) rated habitat amounts to just under a third (32.2%) of the LSA and is located primarily along the central and eastern edges of the LSA (Figure 13.5-33). High rated breeding habitat for black-throated green warbler occurs in small areas within the Coal Processing Site and over a larger portion in the Shaft and Decline Site. It is also present within the eastern side of the extent of underground mining boundary.

Similar to habitat mapping in the LSA, the majority of the RSA (87.9%) is classified as non-suitable breeding habitat for black-throated green warbler (Table 13.5-11 and Figure 13.5-34). Suitable breeding habitat occurs in 12.1% of the RSA, consisting of Moderate (7.7%) and High (4.4%) rated habitat. It is located primarily on the eastern side of the RSA, along major river corridors such as Flatbed Creek and the east side of the Murray River.

Table 13.5-11. Area and Proportion of Habitat within the Local Study Area and Regional Study Area for Black-throated Green Warbler

Suitability Rating	Amount of Habitat in the LSA		Amount of Habitat in the RSA	
	Area (ha)[1]	% of LSA[2]	Area (ha)[1, 3]	% of RSA[2]
Breeding				
High	901	7	10,016	4
Moderate	2,987	25	17,553	8
Low	3,097	26	31,398	14
Nil	5,091	42	168,608	74
Unclassified	14	0	39	0

[1] *LSA = 12,092 ha and RSA = 227,615.8 ha.*
[2] *For ease of presentation, percentages are rounded up or down to the next whole number. However, due to the large number of decimal places, some percentages may not add to 100% (e.g., 99% or 101%).*
[3] *Includes area of LSA.*

13.5.4.11 Waterbirds

The presence of waterbirds is an indicator of the availability of functional wetland habitat. Waterbirds are also an important game species for local hunters and First Nations. The nests and eggs of migratory waterbirds species are protected under the federal *Migratory Bird Convention Act* (1994b), and identifying species of conservation concern during the breeding season supports conservation measures identified under SARA (2002) and the BC *Wildlife Act* (1996b).

Surveys for waterbirds occurred from 2010 to 2012. In 2010, two inventories for waterbirds were conducted within the RSA during the breeding season. The first inventory included an aerial survey which was conducted over a period of three hours between May 18 and 19 during the pre-incubation period (before most females have initiated incubating eggs) and a total of 15 sites were surveyed from the ground on May 19 and 20 (Appendix 13-A). The second inventory was conducted in July during the brooding period when parent birds accompanied their young. An aerial survey was conducted for four hours on July 18 and ground surveys were conducted at 105 sites on July 21 to 26 (Appendix 13-A). Waterbirds were inventoried during the fall 2011 and spring 2012 staging periods. During spring staging, aerial surveys were conducted for 5.8 hours on May 2, 2012 and ground surveys were conducted at 30 sites over a period of three days (Appendix 13-A). During fall staging, aerial surveys were conducted for a total of four hours on October 6, 2011 and ground surveys were conducted at 30 sites between October 4 and 6, 2011 (Appendix 13-A).

A total of 35 species belonging to six waterbird groups were detected during all three years of surveys (Table 13.5-12); dabbling ducks (7 species), diving and sea ducks (10 species), loons and grebes (6 species), riverine birds (3 species), geese and swans (2 species), and shorebirds (7 species). The most commonly observed species were mallard (*Anas platyrhynchos*), lesser scaup (*Aythya affinis*), ring-necked duck (*Aythya collaris*), Canada goose (*Branta canadensis*), Barrow's goldeneye (*Buchephala islandica*), hooded merganser (*Lophodytes cucullatus*), and American green-winged teal (*Anas crecca*).

Figure 13.5-33

Black-throated Green Warbler: Breeding Habitat in the Local Study Area

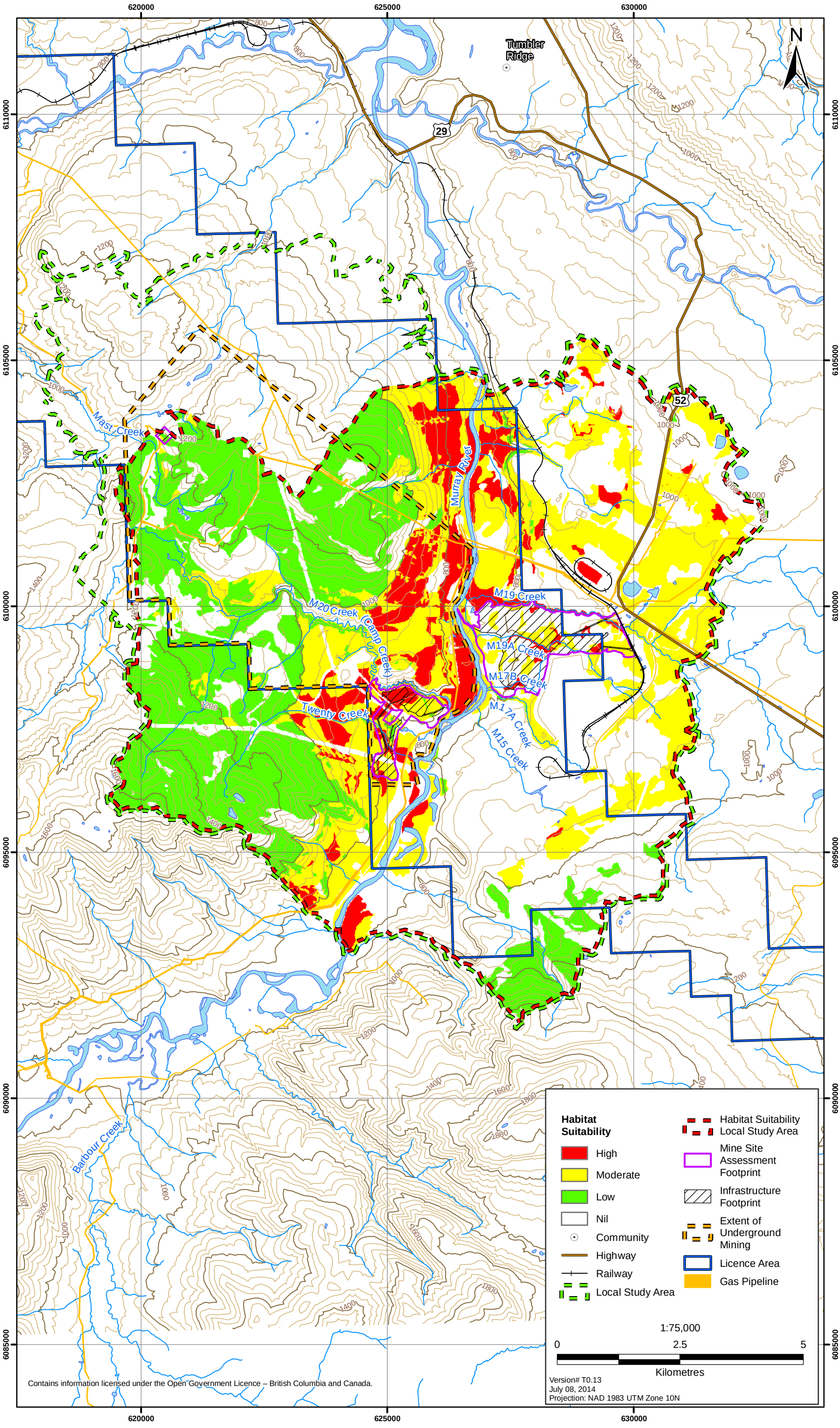


Figure 13.5-34
Black-throated Green Warbler: Breeding Habitat in the Regional Study Area

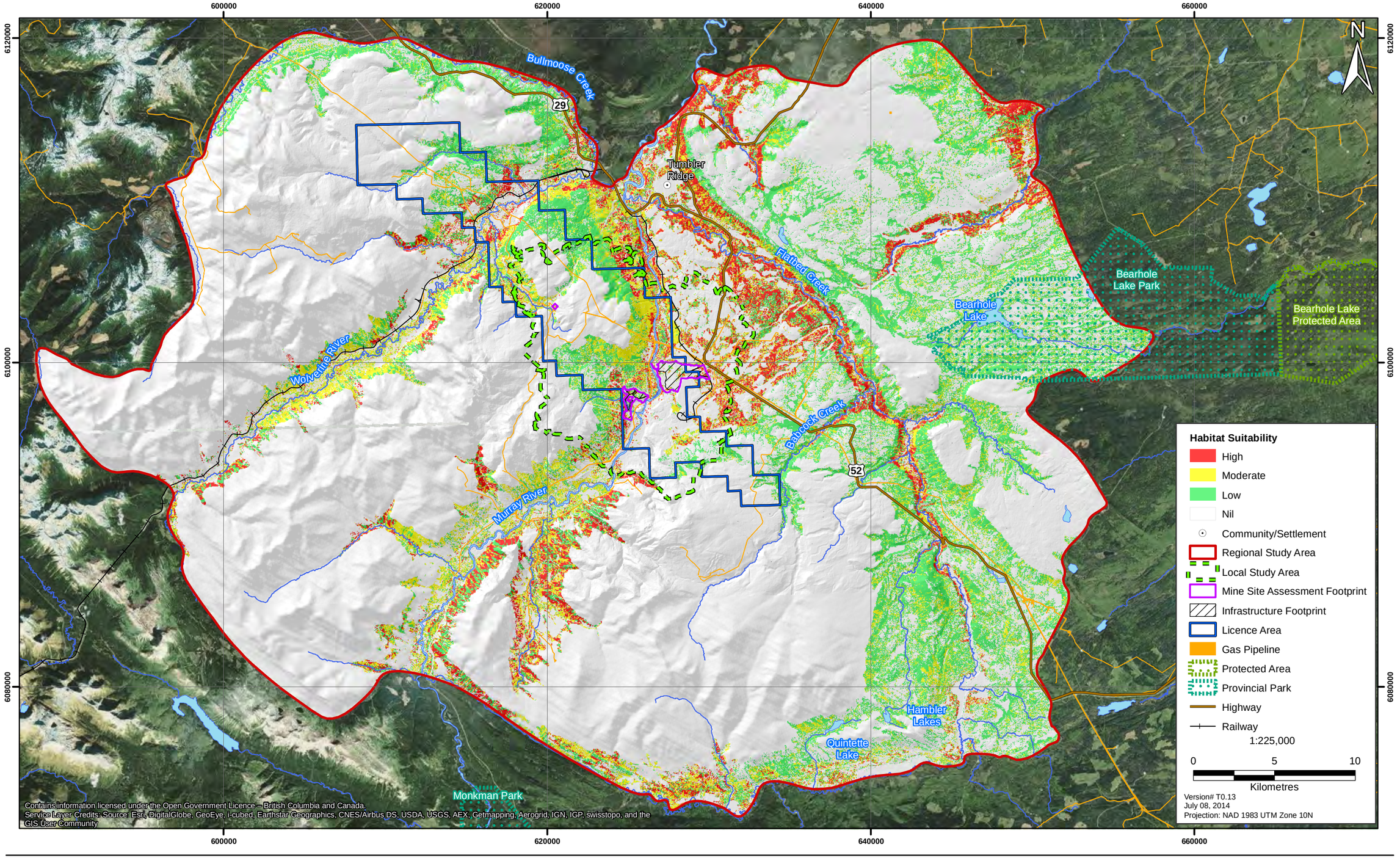


Table 13.5-12. Total Waterbird Observations, 2010 to 2012

Group	Species	Scientific Name	Waterbird Survey												
			Spring Staging 2012			Pre-Incubation 2010			Brooding 2010			Fall Staging 2011			
			Aerial	Ground	Inc.	Aerial	Ground	Inc.	Aerial	Ground	Inc.	Aerial	Ground	Inc.	Total
Dabbling Ducks	Green-winged teal	*Anas crecca*	35	19	-	3	2	-	23	5	1	16	-	-	104
	American widgeon	*Anas americana*	38	1	-	12	-	-	3	-	-	-	-	-	54
	Blue-winged teal	*Anas discors*	6	2	-	12	-	-	-	-	-	-	-	-	20
	Gadwall	*Anas strepera*	2	-	-	-	-	-	-	2	-	20	-	-	24
	Mallard	*Anas platyrhynchos*	101	26	-	51	6	2	36	2	-	113	5	3	345
	Northern pintail	*Anas acuta*	63	4	-	-	-	-	-	-	-	-	-	-	67
	Northern shoveler	*Anas clypeata*	11	9	-	6	-	-	-	-	-	-	-	-	26
	Unknown duck		-	-	-	-	-	-	-	-	-	2	1	-	3
Diving and Sea Ducks	Barrow's goldeneye	*Buchephala islandica*	63	16	-	24	4	1	1	10	-	-	-	-	119
	Bufflehead	*Bucephala albeola*	34	14	-	13	2	-	2	-	-	-	-	-	65
	Common goldeneye	*Bucephala clangula*	13	3	-	-	-	-	2	-	1	-	8	4	31
	Common merganser	*Mergus merganser*	17	6	-	9	1	-	8	-	-	-	-	-	41
	Hooded merganser	*Lophodytes cucullatus*	23	-	-	1	-	2	-	-	-	45	7	4	82
	Lesser scaup	*Aythya affinis*	-	-	-	-	-	-	-	7	-	144	74	6	231
	Redhead	*Aythya americana*	4	-	-	-	-	-	-	-	-	-	-	-	4
	Ring-necked duck	*Aythya collaris*	39	4	-	75	17	7	15	-	-	47	27	-	231
	Surf scoter*	*Melanitta perspicillata*	-	-	-	14	-	-	-	-	-	1	13	6	34
	Unknown diver		-	-	-	-	-	-	27	-	-	-	1	43	71
	Unknown goldeneye	*Bucephala islandica/ clangula*	2	-	-	-	-	-	-	-	-	-	-	-	2
	Unknown merganser	*Lophodytes* sp.	-	-	-	-	-	-	-	-	-	1	-	-	1
	Unknown scaup	*Aythya* sp.	32	8	-	-	-	-	-	-	-	-	-	-	40

(continued)

Table 13.5-12. Total Waterbird Observations, 2010 to 2012 (completed)

Group	Species	Scientific Name	Waterbird Survey												
			Spring Staging 2012			Pre-Incubation 2010			Brooding 2010			Fall Staging 2011			
			Aerial	Ground	Inc.	Aerial	Ground	Inc.	Aerial	Ground	Inc.	Aerial	Ground	Inc.	Total
Loons and Grebes	Common loon	*Gavia immer*	-	1	-	-	-	-	-	1	-	-	-	-	2
	Horned grebe*	*Podiceps auritus*	-	-	-	-	-	-	-	-	-	-	5	1	6
	Pacific loon	*Gavia pacifica*	-	-	-	-	-	-	-	-	-	-	-	7	7
	Pied-billed grebe	*Podilymbus podiceps*	-	-	-	-	-	-	-	-	-	-	2	-	2
	Red-necked grebe	*Podiceps grisegena*	-	-	-	-	-	-	-	-	-	-	2	-	2
	Unknown loon	*Gavia* sp.	-	-	-	-	-	-	-	-	-	2	-	1	3
	Unknown grebe (Clark's* or Western)	*Aechmophorus* sp.	-	-	-	-	-	-	-	-	-	1	-	12	13
	Western grebe*	*Aechmophorus occidentalis*	-	-	-	-	-	-	-	-	-	1	-	-	1
Riverine Birds	American dipper	*Cinclus mexicanus*	-	-	1	-	-	-	-	-	-	2	-	-	3
	Belted kingfisher	*Megaceryle alcyon*	-	1	-	-	-	-	-	-	-	-	-	-	1
	Harlequin duck*	*Histrionicus histrionicus*	1	-	-	-	-	2	-	-	-	-	-	-	3
Geese and Swans	Canada goose	*Branta canadensis*	79	21	-	48	-	-	82	10	13	-	-	-	253
	Trumpeter swan	*Cygnus buccinator*	20	4	-	2	-	-	2	6	-	3	-	2	39
Shorebirds	Greater yellowlegs	*Tringa melanoleuca*	5	4	-	2	2	-	2	-	-	-	-	-	15
	Lesser yellowlegs	*Tringa flavipes*	-	-	-	-	-	-	-	3	-	-	-	-	3
	Red-necked phalarope*	*Phalaropus lobatus*	-	-	-	-	-	-	-	-	-	-	1	-	1
	Solitary sandpiper	*Tringa solitaria*	-	-	-	-	3	-	7	8	-	-	-	-	18
	Sora	*Porzana carolina*	-	-	-	-	-	-	-	1	-	-	-	-	1
	Spotted sandpiper	*Actitis macularia*	-	-	-	-	5	3	-	9	2	-	-	-	19
	Unknown sandpiper†		-	3	-	40	-	-	10	-	-	-	-	-	53
	Unknown shorebird		-	-	-	44	-	-	-	-	-	-	-	1	45
	Wilson's snipe	*Gallinago delicata*	-	5	-	-	1	3	-	-	-	-	-	-	9
Total	**Species**		**19**	**19**	**1**	**15**	**10**	**7**	**13**	**12**	**4**	**13**	**10**	**10**	**35**
	Individuals		**588**	**151**	**1**	**356**	**43**	**20**	**220**	**64**	**17**	**398**	**146**	**90**	**2094**

**Species of conservation concern*

†Potentially spotted or solitary sandpiper

Five species of conservation concern were detected during baseline studies; harlequin duck, horned grebe, red-necked phalarope, surf scoter, and western grebe. Harlequin duck and horned grebe are both provincially yellow-listed, red-necked phalarope and surf scoter are blue-listed, and western grebe is red-listed (BC CDC 2013). Provincially, harlequin ducks are ranked as vulnerable during the non-breeding season and are of particular concern because they occupy a unique habitat niche and Pacific populations have undergone significant declines (Robertson and Goudie 1999; BC MSRM 2002). Both the horned grebe and western grebe are designated as Special Concern by COSEWIC (BC CDC 2013). Thirteen Western or Clark's grebes were observed during the fall staging survey. The Clark's grebe is species of conservation concern (provincially red listed); however, it was not possible to verify individuals to species as Western and Clark's grebes are difficult to distinguish at a distance. Horned grebe, red-necked phalarope, and surf scoter were observed within the LSA, northeast of the Coal Processing Site (Figure 13.5-35). All species of conservation concern, with the exception of harlequin duck and red-necked phalarope, were observed outside the LSA in the Bearhole Lake Park boundary. Harlequin ducks were only observed within the RSA along the Wolverine River.

The largest abundances of birds were observed during the staging periods (~1,280 birds) compared to the breeding period (~680 birds), with the highest abundance observed during the spring staging survey. Species richness was also greatest during the spring staging period (24 species) relative to the other seasons surveyed (16 to 18 species). The most commonly observed waterbird groups observed during the staging periods were dabbling and diving ducks, with a greater portion of diving ducks observed during the fall staging period.

Waterbirds observed during ground and aerial surveys conducted during the spring staging period were detected primarily in pond (23%), river (22%), man-made waterbody (17%), and creek habitat (16%). Due to the extent of ice cover on larger waterbodies during the spring staging period, few waterbirds were detected on lakes (8%). In contrast, waterbirds observed during ground and aerial surveys conducted during the fall staging period were detected primarily in lake (60%) and river habitat (17%).

The highest concentrations of waterbirds observed during spring staging surveys were recorded within the LSA along the Murray River south of the Coal Processing Site and south of the Shaft and Decline Site at a water storage pond; high concentrations were also found within the RSA along the Wolverine River, the Murray River southwest of the LSA, along Flatbed Creek northeast of Hambler Lakes in the southeast portion of the RSA, and just north of Bearhole Lake Park (Figure 13.5-36). During fall staging surveys, the largest concentrations of waterbirds were observed within the LSA approximately 2 km northeast of the Mine Site Assessment Footprint and within the RSA in Bearhole Lake Park and south of the LSA along Murray River (Figure 13.5-37). Observations of waterbirds were primarily on lakes (60%) and river habitat (17%).

Breeding evidence (broods, nest, or pairs) was confirmed for 20 species at 50 locations (Figure 13.5-38; Appendix 13-A). Forty breeding pairs of waterbirds, the majority of which were mallard, Barrow's goldeneye, and Canada goose, were detected during pre-incubation surveys. A total of 41broods from 13 species were identified during the breeding survey and were primarily Canada geese, green-winged teal, and mallards. No broods of species of conservation concern were

detected during breeding surveys; however, adult surf scoters were observed within the LSA during the pre-incubation surveys so may potentially be breeding nearby.

The largest concentrations of waterbirds observed during the pre-incubation period were detected in pond (32%), river (21%), and man-made waterbody habitat (18%). The majority of broods were observed on pond or man-made waterbody habitats. A small number of broods were also observed in lake, river, and swamp habitat. Broods were detected primarily within the LSA at a total of 13 sites, two of which were adjacent to the Mine Site Assessment Footprint.

13.5.4.12 Amphibians

The aerial reconnaissance survey was conducted on July 18, 20, and 21, 2010 within the LSA and RSA. This was followed by five days of ground surveys from July 22 to 26, 2010. Four species of amphibians were detected at 11 sites within the RSA during the 2010 field season: western toad (*Anaxyrus boreas*), Columbia spotted frog (*Rana luteiventris*), wood frog (*Lithobates sylvaticus*), and long-toed salamander (*Ambystoma macrodactylum*) (Figure 13.5-39). Nine of these locations were breeding sites (i.e., locations where amphibians in juvenile life stages were recorded). Four breeding sites were located in the LSA; three of these were for western toads.

Breeding evidence was most commonly observed for western toad. Six of the eleven locations had western toad tadpoles and/or toadlets, including two sites where over 500 individuals were counted. One large toadlet aggregation/recruitment site with over a thousand toadlets was detected within the eastern LSA. Columbia spotted frog tadpoles and juveniles were recorded at four locations, including one site where roughly one hundred tadpoles were counted. Three of the four Columbia spotted frog breeding sites were located in the LSA. Wood frog and long-toed salamander breeding was only detected at one site each; one wood frog juvenile was recorded at one location and 15 salamander larvae were detected at the other. Both of these sites were in the LSA.

A total of 66 sites were surveyed during the aerial survey and habitat characteristics were recorded for each site (Appendix 13-A). Most wetlands (73%) were located outside of the LSA and were classified as ponds. Of the 66 wetlands examined, 11 were classified as high-quality toad breeding sites, 51 were classified as moderate, and 4 were rated as poor.

Ground surveys for amphibian breeding activity were conducted at 31 sites (Figure 13.5-39). Nineteen sites were located within the LSA. Surveyors visited nine sites identified during the aerial reconnaissance survey, one of which was rated as high-quality breeding habitat and the remaining eight were rated as moderate. The majority of the sites identified during the aerial reconnaissance survey were inaccessible from the ground and thus surveyors were required to select additional wetlands (n = 22) with good access.

The majority of the wetlands where amphibians were observed were small (~0.5 ha) in size with sluggish to very little water flow (Appendix 13-A). Amphibian sites were located between 889 and 1,247 m elevation (average 1,045 ± 39 m Standard Error). Many wetlands had a gently sloped muddy or gravelly bank and a mix of emergent vegetation such as horsetails, sedges, and aqueous graminoids within the wetted area. All but one wetland were surrounded by an open, set-back forest canopy. Several wetlands appeared to have been created by beaver activity and three sites were roadside ditches.

Figure 13.5-35
Distribution of Waterbird Species of Conservation Concern, 2010-2012

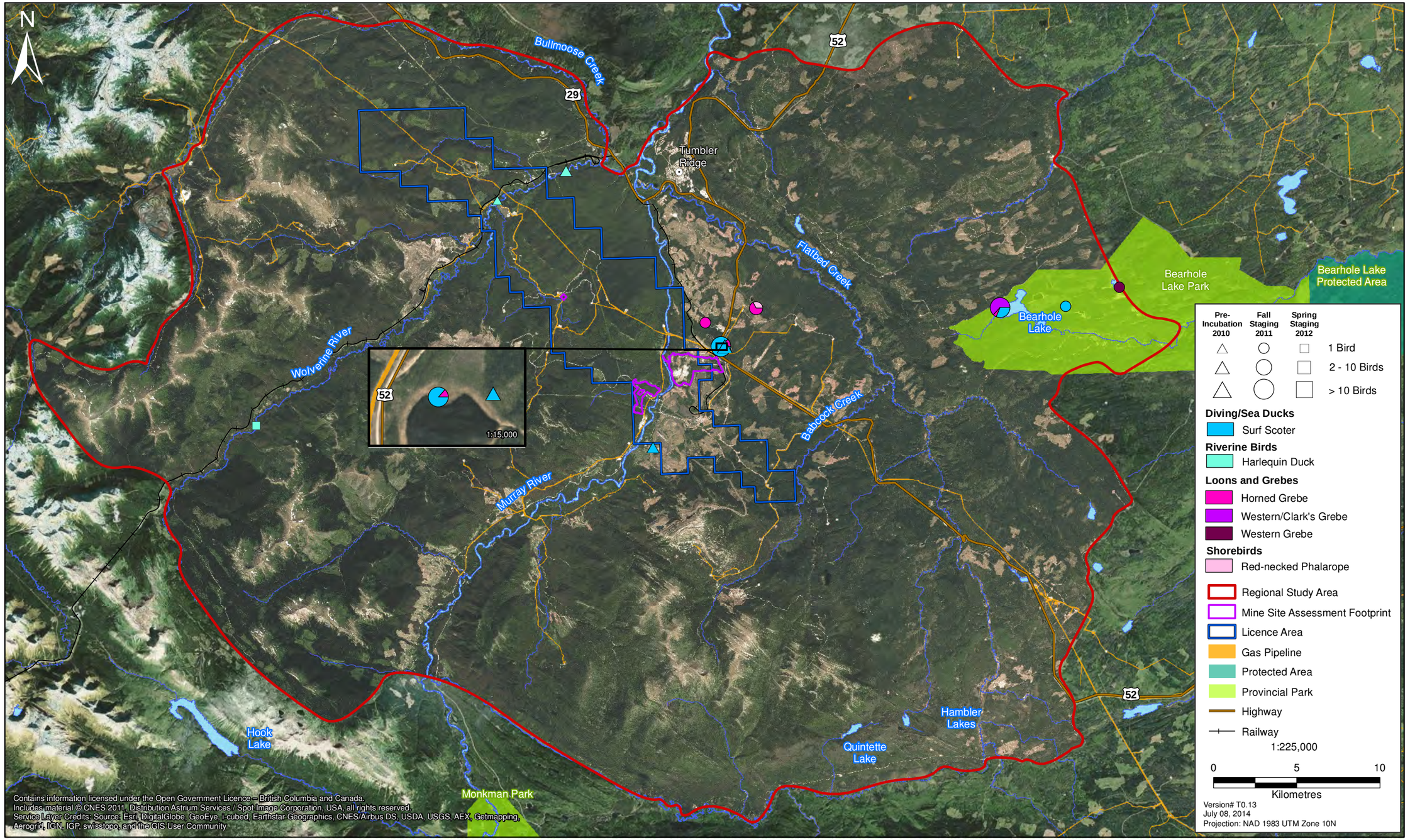


Figure 13.5-36
Distribution and Abundance of Waterbirds during Spring Staging Surveys, 2012

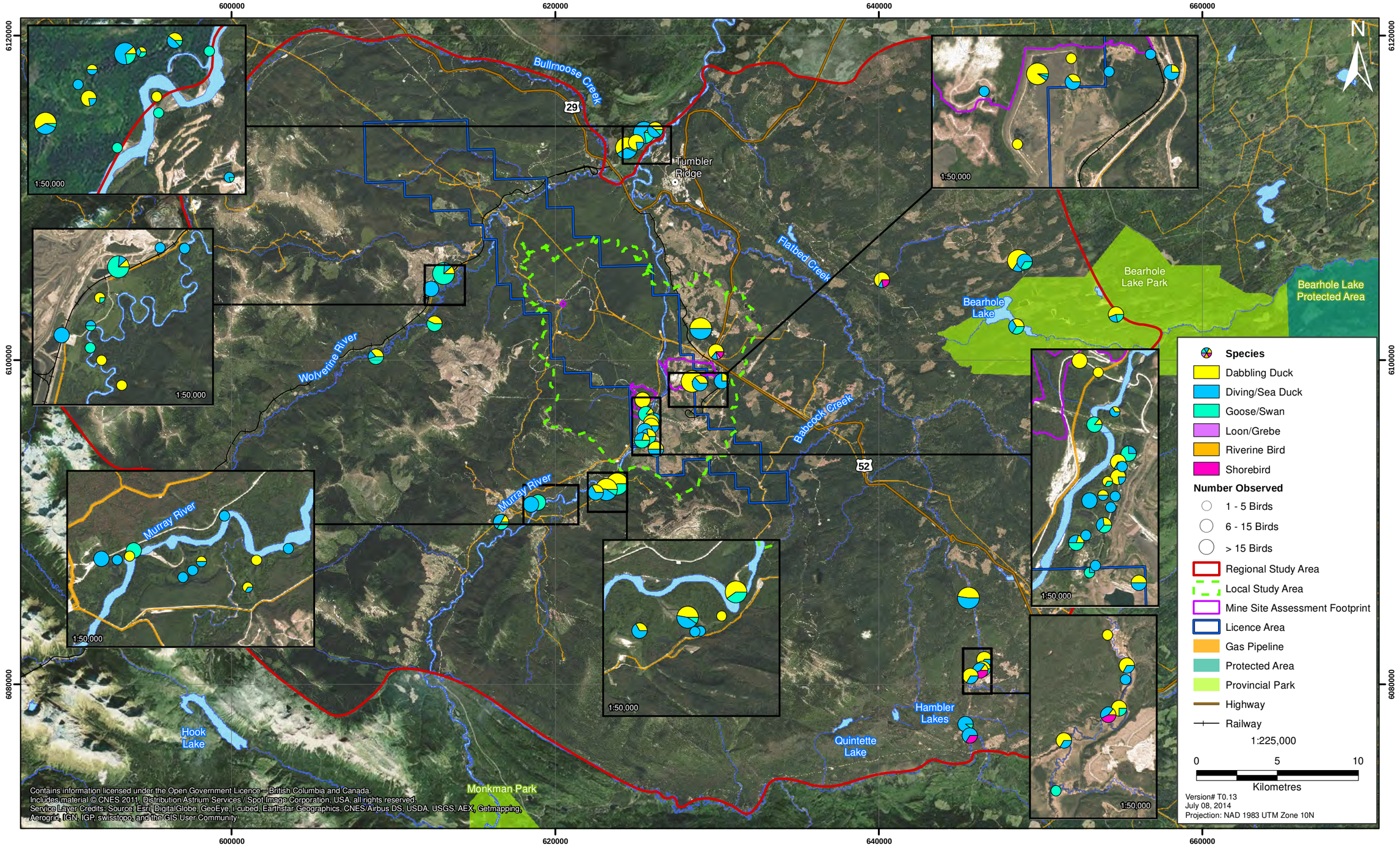


Figure 13.5-37
Distribution and Abundance of Waterbirds during Fall Staging Surveys, 2011

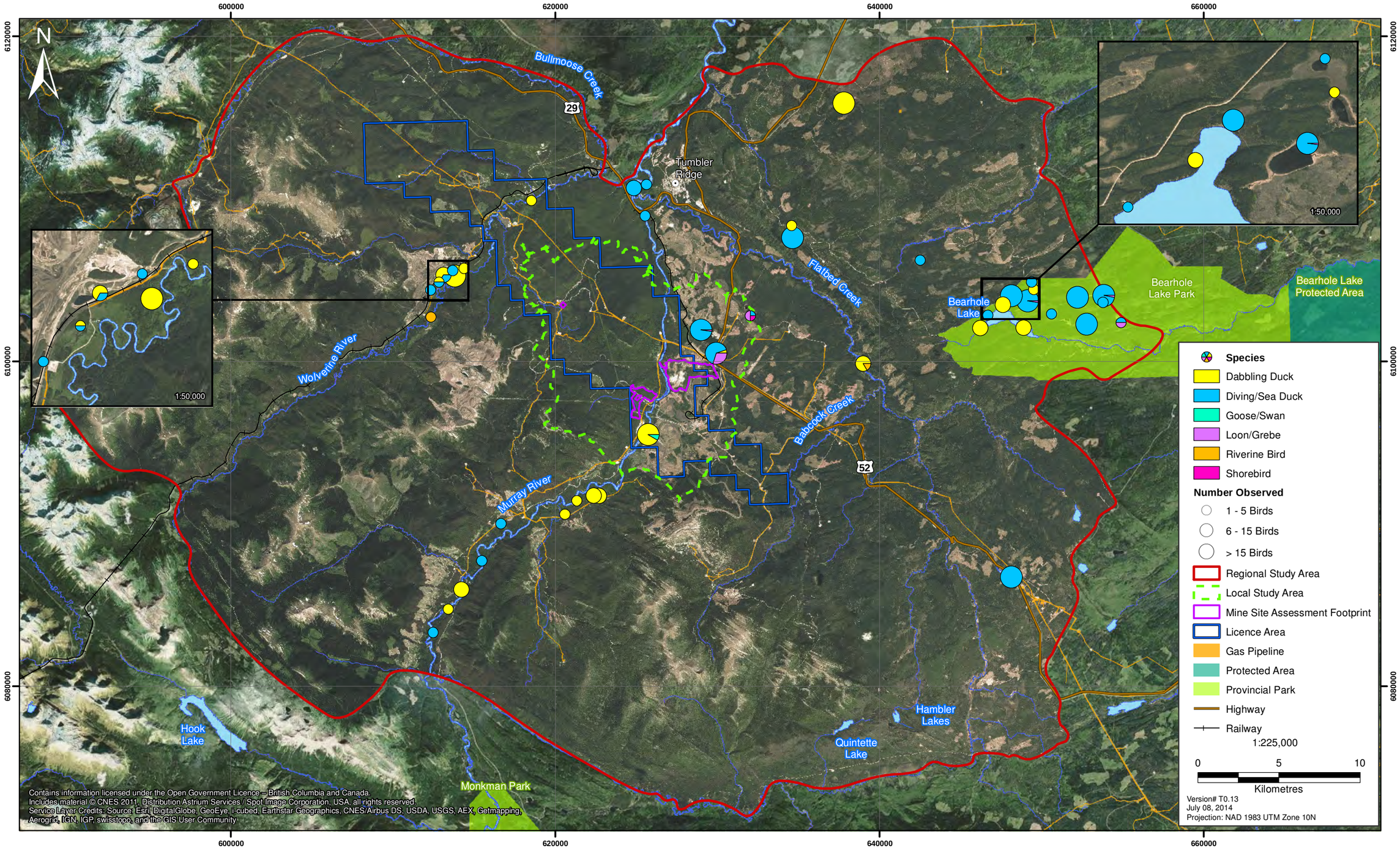


Figure 13.5-38

Distribution and Abundance of Waterbirds during Breeding Surveys, 2010

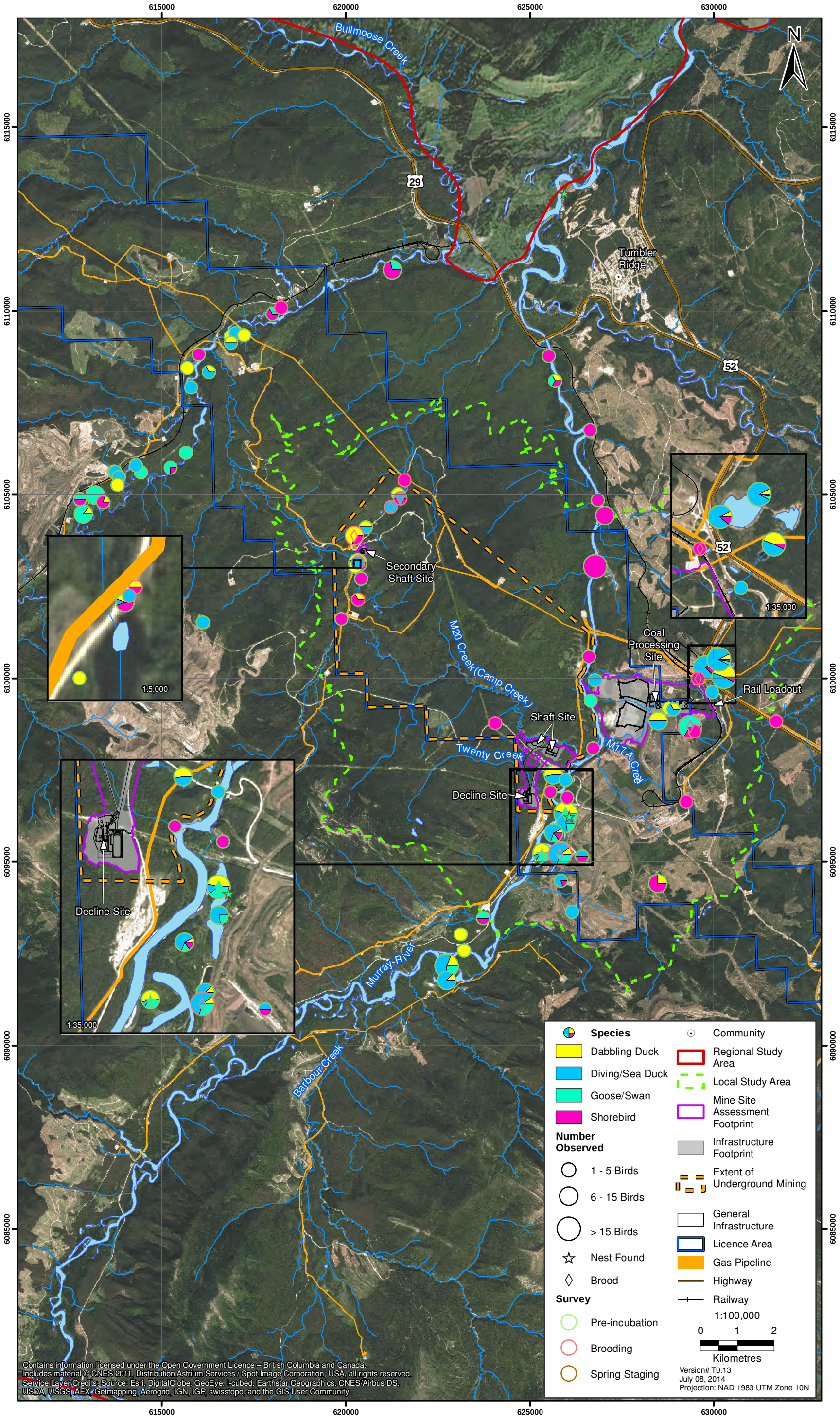
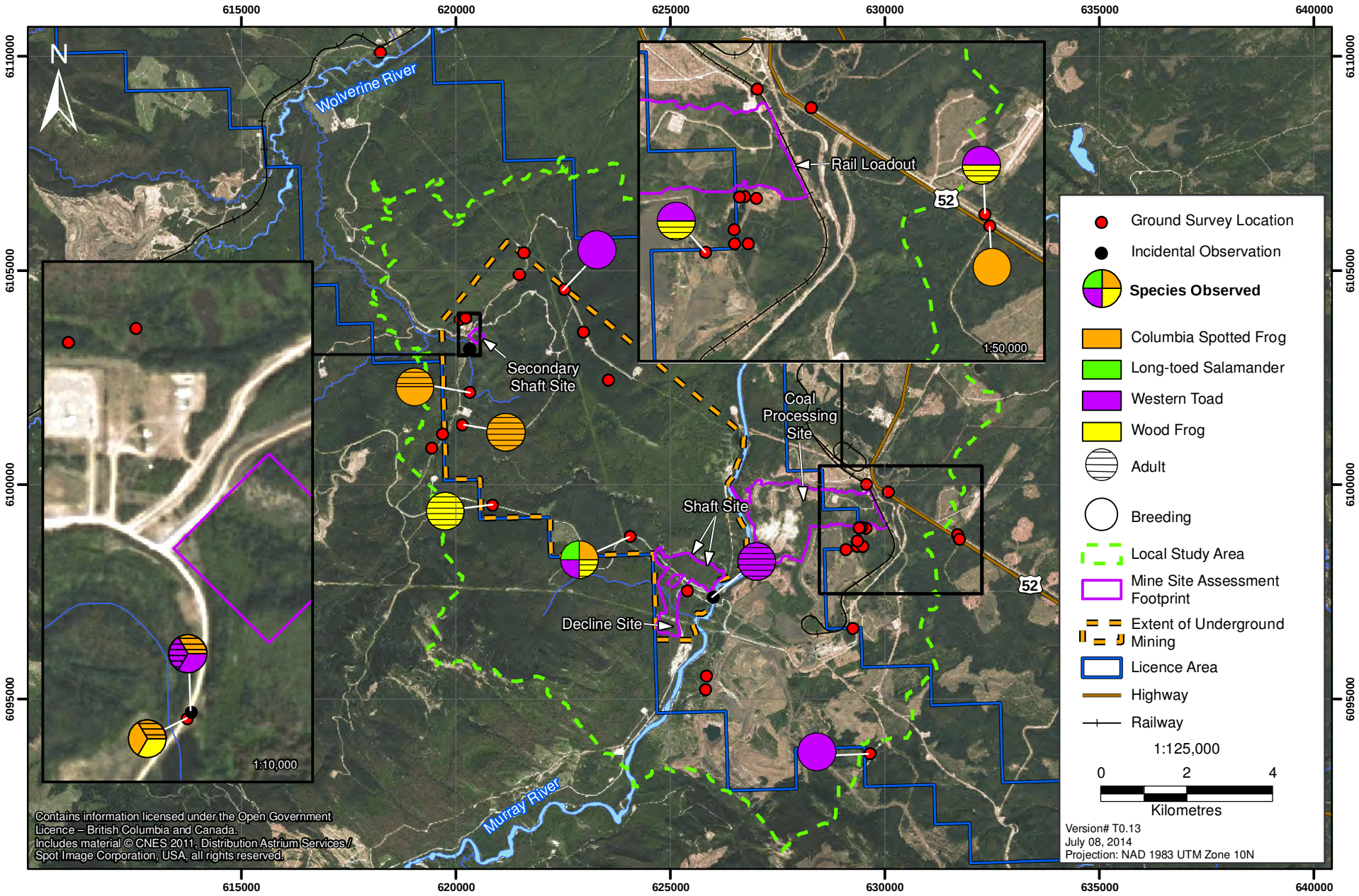


Figure 13.5-39
Ground Survey and Amphibian Detection Locations, 2010



13.6 ESTABLISHING THE SCOPE OF THE EFFECTS ASSESSMENT FOR WILDLIFE AND WILDLIFE HABITAT

This section includes a description of the scoping process used to identify potentially affected Valued Components (VCs), select assessment boundaries, and identify the potential effects of the Project that are likely to arise from the Project's interaction with a VC. Scoping is fundamental to focusing the Application/EIS on those issues where there is the greatest potential to cause significant adverse effects. The scoping process for the assessment of wildlife and wildlife habitat consisted of the following steps:

- *Step 1:* conducting a desk-based review of available scientific data, technical reports, and other Project examples to compile a list of potentially affected VCs in the vicinity of the Project;
- *Step 2:* carrying out detailed field baseline studies to fill information gaps and confirm presence/absence of VCs;
- *Step 3:* considering feedback from the EA Working Group on the proposed list of VCs included in the AIR and the EIS Guidelines;
- *Step 4:* defining assessment boundaries for each wildlife VC; and
- *Step 5:* identifying key potential effects on VCs.

These steps are described in detail below.

13.6.1 Selecting Valued Components

Valued components (VCs) are components of the natural and human environment that are considered to be of scientific, ecological, economic, social, cultural, or heritage importance (CEAA 2012; BC EAO 2013b). To be included in the EA, there must be a perceived likelihood that the VC will be affected by the proposed Project. Valued components are scoped into the environmental assessment based on issues raised during consultation on the dAIR and EIS Guidelines with Aboriginal communities, government agencies, the public and stakeholders. Consideration of certain VCs may also be a legislated requirement, or known to be a concern because of previous project experience. VCs were selected based on the results of these activities, reflecting a balanced and knowledgeable synthesis of a wide range of information. Any species or wildlife group considered as a VC is known to occur in the Project area and is reasonably likely to be affected by, or have an influence on, the Project.

Assessing the effects on wildlife as a VC is sufficiently broad to "split" into subcomponents and define the VCs more narrowly as individual species (e.g., moose) or species groups (e.g., raptors). A number of wildlife VC subcomponents were selected to focus the effects assessment. While individual species and species groups are considered subcomponents to the more general wildlife subject area, effects assessment including determination of significance are completed individually for each subcomponent. These species or focal groups were chosen because they met one or more of the following criteria:

- species at risk or of conservation concern;
- species or focal groups requiring enhanced consideration under the mandates of regulatory agencies such as the BC MFLNRO, the FRPA (2002), the BC Conservation Framework priority, or the Canadian Wildlife Service;

- species identified as having a strong biological importance for the functioning of the ecosystem in the Project area, including importance as keystone, indicator, and/or umbrella species; and/or
- species of cultural, social, and/or economic importance.

The following section reviews the selection criteria used to identify selected VCs and includes a rationale for their inclusion or exclusion in the Application/EIS.

13.6.1.1 Summary of Valued Components Selected for Assessment

The following tables (Table 13.6-1 and 13.6-2) describe the rational for inclusion (Table 13.6-1) or exclusion (Table 13.6-2) of particular candidate wildlife VCs.

Table 13.6-1. Wildlife Valued Components Included in the Effects Assessment

Valued Components	Identified by*			Rationale for Inclusion
	AG	G	P/S	
Woodland caribou	x	x	x	Caribou are culturally important species for First Nations. They have also been identified as socioeconomically important. The RSA overlaps an UWR for caribou that contains low and high elevation ranges. Woodland caribou have been identified as an important species requiring increased management consideration by Dawson Creek LRMP (BC ILMB 1999; Ministry of Employment and Investment 1999). Woodland caribou are also managed under IWMS. Northern ecotype populations of the woodland caribou are provincially listed as S3 and Blue (species of concern), globally listed as G5T5 (demonstrably widespread, abundant, and secure), listed as Schedule 1 under *SARA* (2002), and BC Conservation Framework Priority-listed as 2 under goal 2 (prevent the species and ecosystems from becoming at risk; BC CDC 2013).
Rocky Mountain elk	x		x	Elk are culturally important and hunted species for First Nations. They have been identified as socioeconomically important because of subsistence and recreational hunting. Elk have been identified as a species requiring increased management consideration by Dawson Creek LRMP (BC ILMB 1999; Ministry of Employment and Investment 1999).
Moose	x		x	Moose are identified as a culturally important and hunted species for First Nations. Moose is also a biologically important species and have also been identified as socioeconomically important. Suitable habitat is found throughout the RSA.

(continued)

Table 13.6-1. Wildlife Valued Components Included in the Effects Assessment (continued)

Valued Components	Identified by*			Rationale for Inclusion
	AG	G	P/S	
Mountain goat	x	x	x	Mountain goat is a culturally important species for First Nations. Mountain goat have been identified as an species requiring increased management consideration by Dawson Creek LRMP (BC ILMB 1999; Ministry of Employment and Investment 1999) and the RSA overlaps an approved UWR (BC MOE 2006). Mountain goats are provincially listed as S4 and Yellow (apparently secure), globally listed as G5 (demonstrably widespread, abundant, and secure), and BC Conservation Framework Priority-listed as 1 (highest conservation priority) due to a ranking of 1 on the Conservation Framework goal 2 (prevent species and ecosystems from becoming at risk (prevent species and ecosystems from becoming at risk; BC CDC 2013).
Grizzly bear	x	x	x	Grizzly bear are provincially blue-listed, federally listed species of Special Concern, and are a species of cultural importance for First Nations. They are also economically important to local hunters and guide outfitters. Identified as a species requiring increased management consideration by land management plans including the Dawson Creek LRMP (BC ILMB 1999; Ministry of Employment and Investment 1999). Grizzly bears are also managed under IWMS.
Furbearers (fisher as a representative species)	x	x	x	Fishers are provincially blue-listed, and are a culturally important species trapped by First Nations. They are also identified as being socioeconomically important. Identified as a species requiring increased management under IWMS. Fishers are biologically important as an umbrella species.
Bats	x	x		Provincially blue-listed northern long-eared myotis (*Myotis septentrionalis*) could occur within the LSA and RSA. It is listed in BC's Conservation Framework as 2 for goal 3 (maintaining native species diversity). The little brown myotis (*Myotis lucifugus*) is listed as Endangered by COSEWIC (COSEWIC 2012b) over concerns with white-nose syndrome. It has also been identified as important to First Nations. Because of the lack of regional knowledge about this wildlife group and their ability to habituate to anthropogenic structures, bats are included as a VC.
Raptors	x	x		Nests (year round) and certain raptors are protected under BC *Wildlife Act* (1996b). Group includes culturally important raptors (e.g., bald eagle, golden eagle, northern goshawk) identified by the First Nations and SARA listed species (i.e., northern goshawk and peregrine falcon). Raptors and raptor nests have been confirmed in the RSA.

(continued)

Table 13.6-1. Wildlife Valued Components Included in the Effects Assessment (completed)

Valued Components	Identified by*			Rationale for Inclusion
	AG	G	P/S	
Waterbirds	x	x		Individual birds, eggs and active nests are protected under *Migratory Birds Convention Act* (1994a) and *Wildlife Act* (1996b). Certain waterfowl species are culturally important for First Nations (e.g., geese, ducks, grebes, and swans). There were 35 waterbird species confirmed on waterbodies during baseline studies, including waterbirds (e.g., ducks, geese), cavity-nesting waterfowl (e.g., goldeneyes), and riverine birds (e.g., harlequin duck).
Songbirds (black-throated green warbler as a representative species)	x	x		Individual birds, eggs, and active nests are protected under *Migratory Birds Convention Act* (1994a) and *Wildlife Act* (1996b). The black-throated green warbler is provincially blue-listed, and was observed during baseline studies. Warblers been identified as an important species requiring increased management consideration by Dawson Creek LRMP (BC ILMB 1999; Ministry of Employment and Investment 1999). The black-throated green warbler is also managed under IWMS. This VC also includes culturally important species (e.g., grouse, ptarmigan) for First Nations. There were 72 species of migratory songbirds confirmed in the RSA during baseline studies.
Amphibians (western toad as a representative species)		x		Western toad is a species of Special Concern under Schedule 1 of *SARA* (2002). Confirmed presence in wetlands during baseline studies. This species has a priority rating of 2 for goal 2 in BC's Conservation Framework, meaning that the province is interesting in preventive conservation to keep this species from becoming at risk.

**AG = Aboriginal Group; G = Government; P/S = Public/Stakeholder.*

Table 13.6-2. Valued Components Excluded from the Effects Assessment for Wildlife

Valued Components	Identified by*			Rationale for Exclusion
	AG	G	P/S	
Marten	x			Marten, provincially blue-listed, is identified as an species requiring increased management consideration by land management plans including the Dawson Creek LRMP (BC ILMB 1999; Ministry of Employment and Investment 1999). Marten are considered under the assessment for fisher, a VC with a similar status and habitat usage.
Wolverine	x	x		The wolverine is culturally important for First Nations and is provincially blue-listed. The fisher, a species with similar socioeconomic value was selected. The fisher is an umbrella species, and potential Project effects to wolverine will be reflected in the fisher assessment.

(continued)

Table 13.6-2. Valued Components Excluded from the Effects Assessment for Wildlife (completed)

Valued Components	Identified by*			Rationale for Exclusion
	AG	G	P/S	
Mule deer	x			Mule deer are culturally important for First Nations and hunted by local residents. Excluded because mule deer populations are secure, not at risk in BC, and presence was confirmed in the RSA during baseline surveys. In addition, other ungulates with similar socioeconomic value and higher legislative concern were selected.
Northern goshawk	x	x		Potential Project effects reflected by raptor assessments. Northern goshawk habitat loss is assessed in the raptor assessment.
Trumpeter swan	x	x		Trumpeter swans are a yellow-listed species in BC. They have been highlighted by the CWS as a species requiring increased consideration, and species of interest for First Nations. Twenty-nine observations of trumpeter swan were made during spring and fall staging surveys; ten observations were made during the pre-incubation and brood surveys. Breeding was not confirmed in the LSA. Potential Project effects will be reflected by the waterbird effects assessment.
Reptiles (snakes)	x			Excluded because there are no reptile species of conservation concern in the area, and assessment of other terrestrial species acts as a proxy for snakes.

13.6.2 Selecting Assessment Boundaries

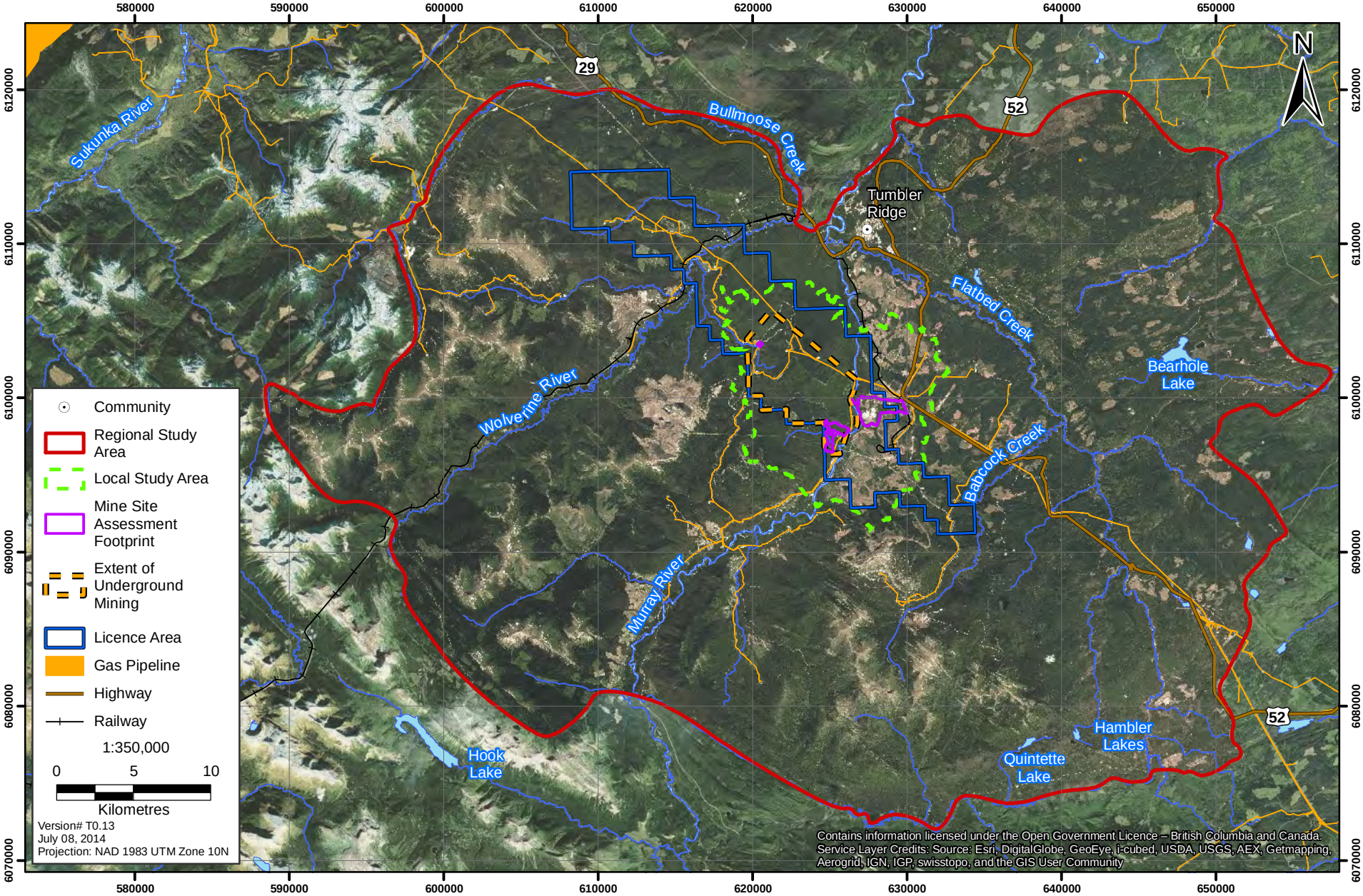
Assessment boundaries define the maximum limit within which the effects assessment is conducted. They encompass the areas within, and times during which, the Project is expected to interact with the VCs, as well as the constraints that may be placed on the assessment of those interactions due to political, social, and economic realities (administrative boundaries), and limitations in predicting or measuring changes (technical boundaries). The definition of these assessment boundaries is an integral part in scoping for wildlife and wildlife habitat, and encompasses possible direct, indirect, and induced effects of the Project on wildlife and wildlife habitat, as well as the trends in processes that may be relevant.

13.6.2.1 Spatial Boundaries

The wildlife and wildlife habitat effects assessment considered two study areas; an effects assessment LSA and RSA (Figure 13.6-1). The effects assessment LSA differs from the baseline LSA. The baseline study areas were defined prior to detailed infrastructure design; therefore, boundaries were designed to ensure extensive baseline surveys were conducted near all potential Project infrastructure. The LSA boundary was refined for the effects assessment to account for the final Project design and focus the assessment to the areas potentially affected.

Figure 13.6-1

Regional Study Area and Local Study Area for Wildlife Effects Assessment



Local Study Area

The wildlife effects assessment LSA is 14,852.5 ha in extent and is defined by a buffer extending at least to the height of land or a 1 km buffer around the outer limits of the proposed infrastructure or the extent of underground mining (Figure 13.6-1). The LSA boundary around the mine site area extends to the height of land, or other natural barriers on the landscape.

For the consideration of wildlife habitat loss using wildlife habitat suitability modelling results, the effects assessment LSA is slightly smaller and 12,092 ha in extent. This area was defined by the available data at the time of modelling and is described in greater detail in Section 13.6.2.4 (Technical Boundaries).

Regional Study Area

The RSA used for the effects assessment is 227,615.8 ha. Design of the RSA took into account the area that provides habitat for wildlife species that may come into contact with proposed Project infrastructure during the course of a season or a lifetime. Other ecological factors, such as height of land, were also considered when delineating boundaries.

13.6.2.2 Temporal Boundaries

Some of the wildlife species considered in the effects assessment follow seasonal migration patterns (e.g., moose), while other species (e.g., grizzly bears) travel long distances to establish their home ranges. Some species, such as the western toad and some resident songbirds, may spend their entire life cycle within the LSA, while other species, such as some raptors and waterbirds, inhabit the area only during specific seasons. Therefore, potential Project effects will vary temporally for each wildlife species, depending on the amount of time each spends in the area. The assessment considered four Project phases:

- **Construction**: 3 years;
- **Operation**: 25 years;
- **Decommissioning and Reclamation**: 3 years (includes project decommissioning, abandonment and reclamation activities, as well as temporary closure, and care and maintenance); and
- **Post Closure**: 30 years (includes ongoing reclamation activities and Post Closure monitoring).

13.6.2.3 Administrative Boundaries

The Dawson Creek LRMP (BC ILMB 1999) identifies a resource management zones (RMZ) along the Murray River. This RMZ is a Major River Corridor (Figure 13.3-2 Sensitive and High-quality Wildlife Habitats), recognized for its importance as a location of high biodiversity value and for providing connectivity for wildlife within the regional landscape. This boundary was used for the assessment of disruption to movement. The RMZ area within the LSA is 2,834 ha and within the RSA is 8,849 ha.

13.6.2.4 Technical Boundaries

To assess Project-related impacts on wildlife and wildlife habitat, a Mine Site Assessment Footprint (the Assessment Footprint) was created around proposed infrastructure. It was created based upon expected locations of infrastructure while incorporating the possibility of changes in the final location of infrastructure. Project-related effects within and outside this boundary are determined by the activity or type of infrastructure present.

For the technical assessment of wildlife habitat suitability modelling, technical boundaries were based on an LSA and RSA designed for conducting baseline studies. Predictive Ecosystem Mapping (PEM) data was used for mapping the larger RSA. Terrestrial Ecosystem Mapping (TEM) data, which provides more precise ecological information relative to PEM, was used within the baseline LSA boundary to establish habitat quality for wildlife VCs. The LSA for the EA was expanded to include approximately an additional 2,700 ha on the northwest side of the LSA. As a result, this additional area does not include habitat suitability modelling based on TEM data for the EA but rather based on the PEM data used for modelling wildlife habitat within the RSA. Therefore, the total amount of high-quality habitat reported within Section 13.5 is less than in Section 13.7 for caribou, moose, mountain goat, grizzly bear, furbearers and black-throated green warbler.

13.6.3 Identifying Potential Effects on Wildlife and Wildlife Habitat

Potential effects on wildlife and wildlife habitat by the Project have been raised during working group meetings with Aboriginal groups and government, and have been identified from mitigation included with best management practices, scientific literature, and technical expertise/professional judgment (Table 13.6-3). How and when these potential effects may arise due to the Project is summarized in Sections 13.6.3.1 to 13.6.3.6 and Table 13.6-7. A detailed description of the potential effects is provided in Section 13.7. Residual effects are described in Section 13.8. Ultimately, the effects are evaluated for their potential to alter survival and reproduction of VC species, and therefore, of the population within the effects assessment boundaries.

Table 13.6-3. Wildlife Effects Identified during Scoping

	Identified by*				
Effects	AG	G	P/S	O	AIR
Habitat Loss and Alteration	X	-	-	X	X
Sensory Disturbance	X	-	-	X	X
Disruption of Movement	-	-	-	X	X
Direct and Indirect Mortality	-	X	-	X	X
Attractants	-	-	-	X	X
Chemical Hazards (Health Effects)	X	X	-	X	X

**AG – Aboriginal Group ; G – Government (including legislation); P/S = Public/stakeholder comments; O = other (SRMP, LRMP, best management practices, professional judgment); AIR – Application Information Requirements*

From the scoping assessment, six potential effects were identified. These potential effects included habitat loss and alteration, sensory disturbance, disruption of movement patterns, direct and indirect mortality, attractants, and chemical hazards. Each of these potential effects, including proposed mitigation and residual effects, are discussed in further detail in Section 13.7 and 13.8.

13.6.3.1 Habitat Loss and Alteration

Habitat loss and alteration includes the direct removal or alteration of wildlife habitat due to the Project. This effect will occur during the Construction phase of the Project due to the clearing of vegetation in the Project footprint. Some habitat loss and alteration will also occur during the Operation phase as a result of ongoing construction and growth of Project features.

The amount of habitat lost or altered for each of the 11 VCs was calculated by overlaying the Mine Site Assessment Footprint on Habitat Suitability Modelling and/or vegetation mapping, from the results of baseline characterization studies for each wildlife VC. The results of these analyses are described in Section 13.7.

Project components in the Underground Mine Site, Coal Processing Site, Shaft Site, Decline Site and Secondary Shaft Site contribute to habitat loss and alteration. No habitat loss will occur due to new roads as the existing road network will be used to access the site and roads leading to the Decline Site, Shaft Site, and Coal Processing Site will be connected to the existing forest roads (Chapter 3, Project Description, Section 3.6.3.6).

Direct habitat loss and alteration was calculated using habitat suitability models (Section 13.6, Appendix 13-C)developed for the following seven VCs:

- caribou (winter, growing, and spring birthing seasons);
- mountain goat (winter and growing seasons);
- moose (winter and growing seasons);
- elk (winter and growing seasons; in LSA only);
- grizzly bear (winter denning, spring, summer, and fall seasons);
- fisher (living and birthing seasons); and
- black-throated green warbler (breeding season).

Habitat suitability mapping was not conducted for bats, raptors, waterbirds, or amphibians (western toads). Habitat loss and alteration assessments for these species was evaluated from habitat features identified during field surveys or from vegetation mapping (TEM in the LSA and PEM in the RSA). The development of TEM and PEM is described in Chapter 11, Assessment of Territorial Ecology Effects, and Chapter 12, Assessment of Wetland Effects.

Habitat loss was calculated for the Mine Site Assessment Footprint (Figure 13.6-1; Section 13.6.2), which is larger than the Infrastructure Footprint. This allows for buffered areas around Project infrastructure and a conservative approach for the assessment of habitat loss and alteration. The Mine Site Assessment Footprint includs the Coal Processing Site, Shaft Site, Decline Site, and Secondary Shafts Site. Subsidence modelling was conducted for the Underground Mine Area and used to calculate the amount of habitat alteration that could occur in this area separately from the calculations of direct habitat loss.

The analysis of habitat loss focused on high-quality habitat as determined by habitat suitability modelling, which includes HSR1 (Very High) and HSR2 (High) classes in a 6-class scheme, and HSR1 (High) in a 4-class scheme. Important wildlife features (e.g., salt licks) identified through baseline studies, land and resource management plans, existing inventories, academic studies, and TK/TU studies were also considered when assessing habitat loss and alteration.

Direct habitat loss and alteration will begin during Construction and continue through Operation, including at the Secondary Shaft Site (see Table 13.6-4). The discussion of habitat loss and figures presented focus on the total amounts lost and altered during the Operation phase.

Wherever possible, reclamation activities will be undertaken to restore habitat during Decommissioning and Reclamation and continue into Post-closure. The areas to be reclaimed and reclamation plans are described in Chapter 24, Environmental Management and Monitoring Plans: Reclamation and Closure. However, reclamation activities are not included in the calculation of habitat loss or alteration.

Subsidence

Subsidence, or changes at the ground surface, as a result of underground long-wall mining will occur in areas where coal is removed in panels (Section 12.6.3.8). Initial subsidence is anticipated to occur at the commencement of long-wall mining, during Operation, as the rock strata in the mined out areas collapses as the mining face advances. Subsidence is anticipated to occur in stages, as panels are mined out, and the extent of subsidence will vary depending on the number of overlapping coal seam panels with greater effects of subsidence anticipated in areas with multiple coal seams being mined in vertically overlapping panels.

Habitat alteration due to subsidence was calculated by buffering the areal extent of the mined panels by 200 m and determining the amount of high-quality habitat that was modelled within this area for each VC. The total was calculated as well as the high-quality habitat amount within the areas with multiple coal seams being mined (1 to 5 panels).

Changes at the ground surface can be complex and difficult to predict due to the heterogeneous nature of geological formations, topography and other variables. The potential effects to terrain and wetlands are discussed Section 12.6.3.8. Where wetlands occur downstream of hydrological changes, alterations in quality and quantity can have negative effects on wetland biochemical, hydrologic, habitat, and diversity functions as well as extent (Section 12.6.3.8).

While the general mechanisms and effects of subsidence are known, predicting specific effects of subsidence on wildlife habitat are difficult due to the complex interactions between subsidence, ground water flow, and geology in areas with variable topography and geology. For the effects assessment on wildlife, the potential effects of subsidence on wildlife habitat are 1) presented as the total amount of high-quality or suitable wildlife habitat anticipated to be affected due to subsidence within a 200 m buffer around all of the underground panels; 2) presented as the relative level of risk of change to high-quality or suitable habitat based on the number of overlapping panels as detailed in the Project Description (Section 3.6) with a 100 m buffer around individual panels, and 3) for wetland and riverine wildlife habitat downstream of the buffered (200 m) subsidence area is

considered, and presented separately, as changes to the flow of M20 Creek and the upper reaches of Mast Creek may occur as a result of changes to hydrology within the area of subsidence (discussed in aquatic effects; Section 8).

It is not clear how wildlife habitat may change and the effects of subsidence may positively or negatively influence wildlife habitat quality in these areas. Thus, results are predictions of change to wildlife high-quality or suitable habitat, but not necessarily degradation of habitat, as new habitat may also be created for some wildlife VCs.

At the moment, the subsidence area is a low and intermediate elevation conifer forest, with wetlands at the western edge of the subsidence zone. In the best case scenario, both the forest and wetlands would be unaffected by subsidence. Should subsidence alter the hydrology of the wetlands, then the wetlands could increase or decrease in size. The conifer forest on the site is unlikely to be altered considerably and will still offer habitat to wildlife species.

13.6.3.2 Sensory Disturbance

Sensory disturbance from Project-related light or noise and human presence may alter the behaviours of wildlife species, resulting in behavioural changes or habitat avoidance. Hence, sensory disturbance can be considered functional habitat loss for wildlife VCs. This section discusses the potential effects of sensory disturbance on wildlife VCs in the Project area and the assessment of effects of disturbance on individual wildlife VCs are detailed in Section 13.7. Sensory disturbance is anticipated to be minimized during the Decommissioning and Reclamation and Post Closure as it would result only from human activity and vehicle traffic on site for monitoring and maintenance activities during these phases.

Light

Artificial lighting can have negative effects for migratory birds when combined with high towers or buildings (Trapp 1998; FLAP 2010). Migratory birds can become disoriented by lighted towers, and mortality events may result (T. Longcore and Rich 2004). Human disturbance can cause nest abandonment and subsequent higher predation rates (Hockin et al. 1992). All of these disturbance types can reduce reproduction rates and local population size.

Bats and owls may also be attracted to the abundance of prey (insects and small mammals) associated with artificial lighting, or *Myotis* species may avoid bright lights as a predator avoidance strategy (Bat Conservation Trust 2008). The potential effect of lights on bats and owls can be minimized by modifying light design and use.

Noise

Noise affects wildlife species in three primary ways. The source, duration, and intensity of noise all influence the nature and magnitude of observed effects and determine if wildlife exhibit an acute response (flight), a chronic response (altering behaviour and abandoning an area), or habituation (developed tolerance).

Likely the most common response to disturbance, is a behavioural response, where animals may become disturbed and may lose time and energy from key behaviours such as feeding, breeding, or watching for predators. The loss of time devoted to essential activities can ultimately lead to reduced body condition or health (Kraabel and Miller 1997), reduced reproductive success, and/or mortality of offspring and parent—a chronic effect. A behavioural response can also occur when animals avoid habitats near sources of disturbance, resulting in the functional loss of that habitat (D. H. Ward et al. 1999; Gibeau et al. 2002; Bautista et al. 2004). The disturbance may cause animals to abandon their current range. These range shifts can result in mortality due to unfamiliarity with new habitat.

Effects of sound on a species most commonly depends on amplitude (volume) and frequency (pitch). Sound levels decrease with distance from the source, and as such it is important to reference the distance between the source and the location of a sound pressure level reading. Different animals are sensitive to different frequency ranges; bats are sensitive to ultrasound (above 20 kilohertz) frequencies, whereas some birds (Kreithen and Quine 1979), amphibians (Hetherington 1992), and large mammals are sensitive to infrasound (below 20 hertz).

Some species have been found to respond to specific levels of noise above background noise, termed a "threshold level." For example, grizzly bears are reported to avoid areas (78 to 80% of the time) with noise levels greater than 60 dBC (Archibald, Ellis, and Hamilton 1987). Ungulates respond to aircraft overflights and sonic booms at noise levels between 85 and 108 dB Lpeak (Manci et al. 1988; Weisenberger et al. 1996; Reimers and Colman 2006). Bird densities have been found to decrease within 1 km of infrastructure areas (Benitez-Lopez, Alkemade, and Verweij 2010), and a series of studies on birds in grasslands reported that the abundance and diversity of birds began to drop when noise levels reached 47 ± 3.5 dBA near roads (baseline 38 ± 5 dBA; Reijnen and Foppen 1994, 1995; Reijnen, Foppen, and Meeuwsen 1996).

During Construction, potential sources of continuous Project noise include vegetation clearing and infrastructure construction. Instantaneous/short duration noises include vehicle and train traffic. During Operation, potential sources of Project noise include industrial noise at the mine site and vehicle and train traffic.

Methodology for Assessing Effects of Sensory Disturbance on Wildlife

Many sources of sensory disturbance have overlapping disturbance effects. For example, an increase in traffic volume along roads is a source of both noise and visual disturbance. For this assessment, it is assumed that noise levels travel farther than visual disturbances; therefore, the assessment of sensory disturbance is based on the effects of increased noise from Project development.

For the sensory disturbance assessment, the area outside of the Mine Site Assessment Footprint that would be affected by noise was evaluated as functionally lost habitat. The effects of noise on wildlife was assessed using predicted noise models for the Project (Appendix 18-C, Noise Modelling Report), which produced a map of sound emanating from sources. For a point source noise, the noise modelling resembles a topographic map with decreasing sound contours with increasing distance. The area of wildlife habitat affected was calculated by choosing specific noise level contours from the modelling.

In general, wildlife tend to have the strongest reactions to noise when the noise is occurs with other stimuli, such as the presence of people, dust, lights, and smells. For this reason, the area at the Mine Site Assessment Footprint where continuous noise occurs above a threshold of 45 dBA Ln is considered functionally lost habitat.

Continuous noise levels from Project-related activities are presented as "A-weighted" decibels (dBA), which incorporates the noise frequencies that are audible to the human ear. The 45 dBA distance category was selected based on chronic noise threshold values identified for birds (47 dBA; Reijnen and Foppen 1994, 1995; Reijnen, Foppen, and Meeuwsen 1996). In addition, the Environment Code of Practice for Metal Mines (Environment Canada 2010) recommends that ambient noise from mining operations and its effect on wildlife should meet the objectives for residential areas; the sound pressure level from mining activities should not exceed 55 dBA during the day and 45 dBA at night. Therefore, this assessment has taken a conservative approach and modelled the area where the sound pressure level occurs at 45 dBA and higher in wildlife habitat. Traffic and train noise was included in Project noise models (45 dBA Ln) averaged over the 12-hour period and evaluated as a continuous noise, which accounts for a minimal amount of disturbance.

Wildlife also react to noise when there is a visual stimulus, such as a passing vehicle. As a consequence, the area where the instantaneous noise of passing vehicles is higher than 75 dBA LAE is considered degraded habitat (Figure 13.6-2).

The third type of noise due to the Project is noise from moving trains. Wildlife appear to react the least to noise when it is unconnected to a visual stimulus. The noise from the trains will be a low frequency rumble transmitted through the ground and the forested environment where the majority of the train tracks are located. Hence, the area where the instantaneous noise is higher than 75 dBA LAE will be considered the area where wildlife will have a low-level disturbance response.

Consequently, three types of noise and response are reported for each wildlife species:

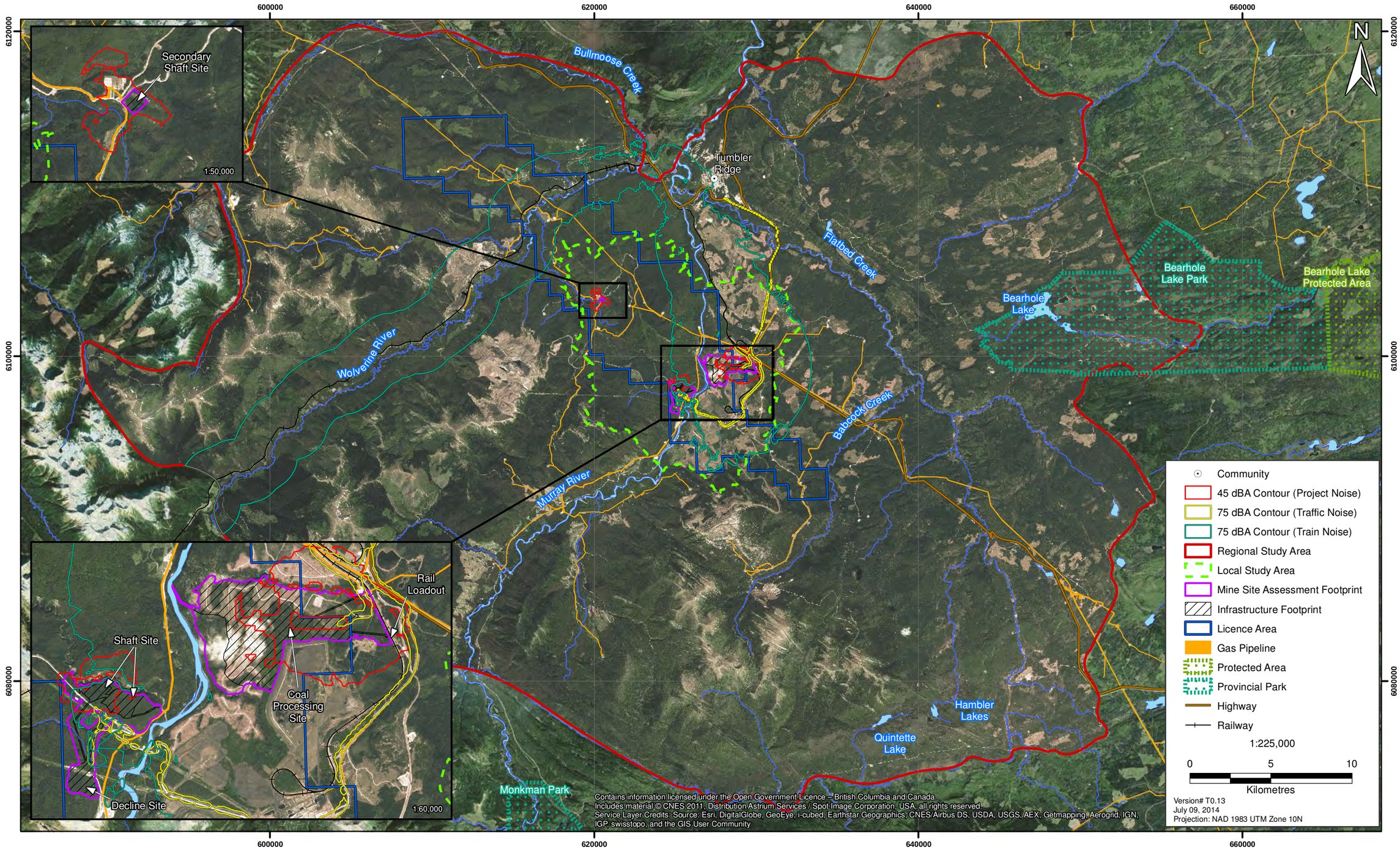
1. Project noise at the Mine Site Assessment Footprint = functionally lost
2. Vehicle noise along the access roads = degraded habitat
3. Train noise along the train route = low level disturbance

Appendix 18-C, Noise Modelling Report, provides a description and definitions of the various types of noise.

13.6.3.3 Disruption of Movement

Wildlife may be affected by industrial projects if their natural movement corridors are blocked by infrastructure or if noise and other disturbance prevents wildlife from using the movement corridor. Disruption of movement was assessed within the Murray River Major River Corridor RMZ (BC ILMB 1999). During Construction and Operation, construction of project facilities and noise was evaluated for their potential to alter wildlife movement in the Major River Corridor RMZ. During the Decommissioning and Reclamation and Post Closure any effects of disturbance on the movement of wildlife is anticipated to be minimal.

Figure 13.6-2
Sensory Disturbance Noise Profiles due to Project Activities within the Local and Regional Study Area – Operation



The proportion of the area within the Major River Corridor that is either permanently or functionally lost or altered due to the Mine Site Assessment Footprints, predicted subsidence, and continuous project noise >45 dbA was calculated. Instantaneous traffic and train noise was not included as it was assumed that wildlife would still use the corridor when these noise levels are not elevated.

13.6.3.4 Direct and Indirect Mortality

Direct mortality includes mortality to wildlife that is directly a result of Project activities (e.g. due to machinery, vehicular traffic, etc.). During Construction, direct mortality could result from vegetation clearing and increased vehicle traffic. During Operation, direct mortality could result from increased vehicle traffic. During Decommissioning and Reclamation and Post-closure, the effects of direct mortality are anticipated to subside as a result of less machinery and traffic activity on the site. Thus, the effects assessment evaluates the potential effects of increased traffic and direct mortality on wildlife VCs during Construction and Operation, only.

Indirect mortality is typically evaluated for mining projects because it may occur when new roads are constructed and result in an increase or redistribution of hunting pressure, both legal and illegal, to new areas. Considerable research over the past 30 years has shown that the primary effect of new linear features (e.g., roads) on wildlife has been to increase access for recreation users and hunters (Andrews 1990; Gates 1992; Nellemann et al. 2003; Reed 2004). These effects when a new road or other linear feature provides access to an otherwise inaccessible area. The Project will be accessed via existing service roads which connect to Highway 52 to the south east of the LSA and Highway 29 the north of the LSA.

No new access roads are planned to be constructed for the Project and therefore, indirect mortality due to new access (and new areas for hunters) is not evaluated for any wildlife VCs. The Project is accessed from Highway 52, the Murray River Forest Service Road, Mast Road, and a short access road to the Coal Processing Site. Short, on-site Project roads have been constructed as part of Bulk Sample, and an existing road will be upgraded at the Coal Processing Site.

Speed limits will be followed on Highway 52 and the Murray River FSR and on on-site Project roads. No new public access will be created. The Murray River FSR is already in operation and on-site Project roads will not be accessible to the Public. At Closure, on-site access roads will be decommissioned.

13.6.3.5 Attractants

Wildlife such as grizzly bears and furbearers may be attracted to the Project area by attractants such as food wastes, and other anthropogenic attractants such as road use chemicals, fuels and oils, and chemicals used during mine product processing. During Construction and Operation, wildlife may become attracted to areas where work crews are working as a result from odours due to food and other wastes and chemicals used by construction crews. These effects are anticipated to subside during Decommissioning and Reclamation and Post Closure when less people are on site. Thus the effects assessment focuses on the potential effects of attractants during Construction and Operation.

13.6.3.6 Chemical Hazards

Exposure to chemical hazards was identified as a potential effect for wildlife VCs (Table 13.6-3). For the purposes of this assessment, a chemical hazard is defined as a chemical that has the potential to cause an adverse health effect on wildlife due to Project development and activities. During the Operation, Decommissioning and Reclamation, and Post Closure phases, wildlife may uptake chemicals of potential concern (COPCs) from water that exceeds water quality guidelines in water storage ponds or receiving environments, from ingestion of dust, or via bioaccumulation from vegetation or prey species which have accumulated these chemicals.

Methodology for Assessing Effects of Chemical Hazards on Wildlife

Wildlife exposed to elevated concentrations of a COPC may be affected by these chemicals if they are taken up into their bodies from the environment and exceed effect thresholds. In order to determine the potential effects of Project-related COPCs on VCs, the following three factors were considered:

1. A COPC has to be present due to Project activities at a sufficiently high concentration to cause toxicological or physical effects;
2. A wildlife VC receptor has to be present; and
3. A pathway must exist from the point of release of the chemical to the Wildlife VC receptor and the receptor must be able to take up the chemical.

Project-related sources of COPCs were evaluated based on the presence of metals in water or fugitive dust (i.e., exposure pathways). COPCs that can bioaccumulate in the food chain (e.g., mercury, molybdenum, selenium) were considered as part of the exposure pathway assessment. If residual effects due to a COPC were identified in wildlife prey species, their predator species would also be scoped in due to potential for exposure to COPCs via the food chain.

Baseline and predictive study results from the following reports were used to support the effects assessment for chemical hazards for wildlife:

- Murray River Project 2010 to 2013 Wildlife Baseline Report (Appendix 13-A);
- Murray River Project 2013 Wildlife Habitat Ratings Study Final Report (Appendix 13-B);
- Murray River Project Wildlife Habitat Ratings for Local Study Area (Appendix 13-C);
- Air Quality Modelling Report (Appendix 6-B);
- Predicted Metal Concentrations Associated with Fugitive Dust at Sites within the Air Quality Modelling Domain (Appendix 18-D);
- Predicted Metal Concentrations in Soil from Dust Deposition (Appendix 18-E); and
- Water Quality Predictive Study (Appendix 8-E).

Screening Procedure for the Selection of Contaminants of Potential Concern

Selection of COPCs and rationale for inclusion and exclusion of individual COPCs and wildlife VCs to these chemical hazards is outlined in the following sections and are summarized in Table 13.6-4.

Table 13.6-4. Sources of Chemicals of Potential Concern Evaluated for Valued Components

Valued Component	COPC in Water	COPC in fugitive dust
Caribou	NA	NA
Moose	NA	NA
Mountain goat	NA	NA
Elk	NA	NA
Grizzly bear	NA	NA
Furbearers	NA	NA
Bats	NA	NA
Raptors	NA	NA
Songbirds	NA	NA
Waterbirds	**Yes**	NA
Western toad	**Yes**	NA

NA = Not assessed, since no COPCs were identified.

The screening process for COPCs in surface water and fugitive dust (depositing on soil) involved screening against two assessment criteria: applicable guidelines and baseline concentrations. In the first screening step for water quality, BC-specific wildlife water quality guidelines for metals (BC MOE 2014) were compared to modelled water metal concentrations. In the first screening step for fugitive dust, predicted metal concentrations in soil from deposition of fugitive dust were screened against CCME Guidelines for the Protection of Environmental and Human Health for agricultural land (CCME 2014).

Hazard quotients (HQs) were calculated by dividing the predicted concentrations of a metal by the appropriate wildlife guideline limit in each relevant environmental medium (i.e., water and soil). COPCs with a HQ less than 1.0 were screened out of the wildlife chemical effects assessment, since these COPCs would not be expected to cause adverse effects in wildlife receptors.

Metals with a HQ greater than 1.0 relative to the guideline were retained for a second screening step. In the second screening step, the predicted metal concentrations were compared to the mean baseline concentration. This step was done to ensure that all COPCs identified and carried through the wildlife chemical assessment process were only those COPCs with concentrations that were predicted to increase due to Project-related activities.

At the end of the screening process for water quality, any COPCs that had a HQ greater than 1.0 relative to guideline and a HQ greater than 1.0 relative to baseline concentrations were retained as COPCs in the wildlife chemical hazard assessment. Details of the screening procedure, including wildlife water quality guidelines, and the resulting COPC selections for water are provided in Chapter 8 and Appendix 8-G. Details of the screening procedure and the resulting COPC selections for soil are provided in Chapter 18 (Section 18.8.3.3 and Table 18.8-3).

In the case where a COPC in water was retained for the wildlife chemical hazard assessment, individual wildlife VCs were screened for their potential to overlap the areas anticipated to result in elevated concentrations of COPCs using data from the baseline studies (Section 13.5; Appendix 13-A) and habitat suitability modelling results (Section 13.5; Appendix 13-B and C). If wildlife VCs and their habitat (high-quality habitat) are not present in the areas predicted to result in elevated COPC concentrations, these wildlife VCs were screened out of further wildlife chemical hazard assessment.

If a wildlife VC or their habitat is present in areas predicted to result in elevated concentrations of COPCs (as described above), wildlife were also screened for their potential to take up the retained COPC (i.e., consideration of whether a route of exposure exists). Only wildlife VCs determined to have a route of exposure to the COPC were further retained for chemical hazard assessment, and the interaction was then evaluated for the potential to result in residual effects on the VC in Section 13.7. A total of two wildlife VCs (i.e., waterbirds and amphibians) were retained for the assessment of health risks due to metals.

Potential Contaminants Excluded from Consideration

Chemicals associated with mining activities include those used by the mine during the Construction and Operation phases. Examples of chemicals used on-site will include materials such as fuel, oil and waste oil, hydraulic fluid, flocculants, chemical reagents and solvents, lead acid batteries, and oil filters. These chemicals will be stored and handled according to safe handling and storage procedures (Chapter 3, Project Description; Section 24.9, Explosives and Nitrogen Management Plan; and Section 24.13, Waste Management Plan) and are not anticipated to be released into the environment.

Selection of Contaminants of Potential Concern in Water

Water quality is a key indicator of environmental health as it is linked to wildlife which use and may consume surface water. Several Project-related activities have the potential to result in changes to surface water quality within the wildlife LSA and could result in downstream effects if not mitigated. Project activities that could result in erosion and sedimentation, atmospheric deposition, discharges of effluent, groundwater interactions, and seepage, have the potential to change water quality, and are discussed in Chapter 8 (Assessment of Surface Water and Aquatic Resources Effects). The evaluation of residual effects to surface water quality during all Project phases is assessed in Section 8.8.

Water quality guidelines for the protection of wildlife (BC MOE 2010c; Beatty and Russo 2014) were used as the standard to evaluate the potential effects of COPCs in water on wildlife VCs. These water quality guidelines are listed in Table 13.6-5; if a parameter does not have a guideline for wildlife, it is not shown in the table. Where they exist, wildlife guidelines have thresholds at equivalent or higher concentrations to those for the protection of aquatic life (with the exception of molybdenum, which is lower).

Three main Project areas were evaluated for exposure of wildlife to COPCs in water including:

1. Shaft/Decline site ponds;
2. Coal Processing Plant site pond; and
3. the aquatic receiving environment.

Table 13.6-5. Wildlife Guidelines for Water Quality

Parameter	Wildlife Water Quality Guideline (mg/L)
Aluminum (Al)	5
Arsenic (As)	0.025
Boron (B)	5
Copper (Cu)	0.3
Cyanide (Weak Acid Dissociable, WAD)	50
Lead (Pb)	0.100
Mercury (Hg)	0.00002
Molybdenum (Mo)	0.00005
Selenium (Se)	0.002

The concentrations of candidate COPCs were examined in each of these locations during the Construction, Operation, Decommissioning and Reclamation, and Post Closure phases using HQs for modelled water quality parameters (Section 8.8) against water quality guidelines for wildlife (Table 13.6-5) in order to assess if the candidate COPC should be evaluated for potential effects on wildlife VCs. The results of the predicted water quality screening against wildlife guidelines and baseline concentrations are provided in Chapter 8.

Baseline studies (Appendices 13-A, 13-B, and 13-C) indicate that the Mine Site Assessment Area and surrounding areas provide habitat for several wildlife VCs. The Murray River and nearby wetlands have been identified as occupied by bird and amphibian VCs during baseline conditions, and the Murray River RMZ corridor provides high-quality habitat for moose, grizzly bear and furbearer movement. Wildlife are anticipated to largely avoid the Mine Site Assessment Footprint during the Construction and Operation phases of the Project due to habitat loss and alteration (Section 13.6.3.1) and sensory disturbance (Section 13.6.3.2). During Decommissioning and Reclamation, and Post Closure phases, wildlife may resume use of these areas as disturbances subside.

Water quality in the Coal Processing Plant (CPP) pond is predicted to exceed the wildlife guidelines for mercury (during Operation phase), and selenium (during Construction and Operation phases). These COPCs were retained for assessment for their effects to wildlife VCs. The wildlife VCs that could be affected by water quality in the ponds are waterbirds and amphibians, since the ponds may act as habitat and egg-laying vertebrates are at risk for potential effects due to selenium.

In the aquatic receiving environment, the screening procedure identified selenium as the only COPC for the Project during the Decommissioning and Reclamation, and Post-closure phases only in M19A Creek during the months of January, February and March. Aside from selenium in M19A Creek, no other COPCs were identified at any other surface water modelling nodes. No residual effects were predicted to occur for surface water quality within M19A Creek or in the Murray River (Section 8.8.1). Due to the mitigation measures in place (Section 8.7.4) and Project design, discharge and runoff will meet water quality guidelines by the time that contact water reaches M19A Creek or the Murray River. Thus, potential effects of COPCs in water on wildlife were limited to selenium in M19A Creek. Since selenium is bioaccumulative, the potential for effects due to direct (e.g., due to direct water exposure or drinking water) or indirect (i.e., via the food chain) exposure routes were considered.

No wildlife VCs were retained for the assessment of exposure to COPCs in water from M19A Creek. Although egg-laying vertebrates (i.e., birds and amphibians) are the most sensitive wildlife to selenium (D. M. D. Janz, D.K.; Brooks, M.L.; Chapman, P.M.; Gilron, G.; Hoff, D.; Hopkins, W.A.; McIntyre, D.O.; Mebane, C.A.; Palace, V.P.; Skorupa, J.P.; Wayland, M. 2010), they were not retained for assessment of key effects or residual effects. Waterbirds will not be present in or around M19A Creek in the months of January, February and March since they are migratory. Similarly, western toads will not be present in or around M19A Creek during the winter months, since they spend the winter in forested areas and not in or around waterways. Therefore, these egg-laying vertebrates do not have an exposure route at the time when selenium concentrations are predicted to be greater than wildlife water quality guidelines.

Other wildlife VCs (e.g., grizzly bears, furbearers) were excluded since selenium was the only COPC identified in the receiving environment. Selenium may be bioaccumulated by most wildlife but none of the documented incidences of elevated selenium concentrations in tissues of most mammals (except ungulates) indicated any negative impacts to these organisms (reviewed in Puls 1994; D. M. Janz et al. 2010).

While bioaccumulation of selenium is possible for ungulates, these mammals are herbivores. Thus, effects of uptake of bioaccumulative COPCs in these animals would be through direct exposure to soil and vegetation, and the effects of bioaccumulation in these mammals would be more dependent on soil quality. No COPCs were identified in soil (see next section).

Fish-eating top predators (i.e., raptors) were assessed for possible bioaccumulation. No fish were captured in M19A Creek during baseline studies due to a series of beaver dams restricting fish access. Although it is possible that fish could become resident in this creek if or when the beaver dams fail, based on current conditions there in not a risk to fish-eating wildlife since M19A Creek does not contain fish. The water selenium guideline is no longer exceeded once water reaches M19A Creek, and therefore, effects to fish in M19A Creek are not predicted. In addition, most fish species are unlikely to over-winter in M19A Creek and may migrate out the Murray River during the winter period when selenium concentrations are predicted to exceed water quality guidelines (i.e., January to March). Based on this assessment, effects to predators that consume fish are not predicted and has not been carried forward in the assessment.

Contaminants of Potential Concern in Fugitive Dust

Project-related activities that can produce fugitive dust during the Operation phase (which is the phase that was modelled since it is the phase with the highest emissions) include: vehicles travelling on on-site unpaved roads; stockpiles and material handling; and mining activities such as bulldozing and grading.

Dust may accumulate on vegetation and soil, which may be ingested by wildlife. The Air Quality model developed for the assessment of air quality (Chapter 6; Appendix 6-B) used the proposed Project activities and observed climatic conditions in the area to map the likely deposition of fugitive dust. Results of the modelling indicate that dust deposition rates were predicted to be maintained within a 1 km buffer of roads, and within the Mine Site Assessment Footprints only, which are areas considered as habitat lost for wildlife (Section 13.6.3.1).

The screening process for COPCs in fugitive dust during the Operation phase was conducted in Chapter 18 (Human Health Effects Assessment), Section 18.8.3.1, and followed the two-step screening procedure described above. During the Operation phase, predicted mean metal concentrations in soil were lower than CCME Guidelines for the Protection of Environmental and Human Health for agricultural land, except for barium, cadmium, and selenium. However, the predicted mean concentrations for these three metals were lower than the mean baseline concentration plus 10% (Table 18.8-3), with a change relative to baseline concentrations of up to 0.033%. A change in concentration of 0.033% would not be detectable and is considered to be the same as baseline concentrations.

Changes in soil concentration would be expected to be smaller in other phases of the Project (e.g., Decommissioning and Reclamation, Post-Closure) compared to the Operation phase. Therefore, no COPCs were identified based on predicted soil quality during the Operation phase (or any of the Project phases). Since soil ingestion is the primary route of COPC uptake in terrestrial wildlife, COPCs associated with fugitive dust were not considered further.

13.6.3.7 Summary of Potential Effects to be Assessed for Wildlife and Wildlife Habitat

Table 13.6-7 provides a ranking of potential effects on wildlife and wildlife habitat. These potential effects are evaluated in Section 13.7. Residual effects are identified and summarized in Section 13.8 and evaluated for significance in Section 13.9 and summarized in Section 13.10.

13.7 EFFECTS ASSESSMENT AND MITIGATION FOR WILDLIFE AND WILDLIFE HABITAT

Eleven wildlife VCs were chosen in Section 13.6.1 and potential effects to these VCs were identified in Section 13.6.3. This section discusses and evaluates the key effects identified in Table 13.6-7 for each VC and presents mitigation measures to reduce or eliminate these potential effects. This section also identifies any residual effects that may occur to wildlife species despite proposed mitigation and management. Residual effects are then discussed in Section 13.8 and the combined project-related effects on each VC are evaluated in Section 13.9.

13.7.1 Key Effects on Caribou

The Project occurs in the range of the Quintette caribou herd, which was assessed for potential Project-related effects. Habitat loss and alteration, sensory disturbance, and disruption of movement were considered for the effects assessment because those effects have the potential to interact with caribou and result in a residual effect on caribou populations. Four effects were scoped out of the assessment for caribou: direct mortality; indirect mortality; attractants; and chemical hazards.

The potential for direct mortality was scoped out of this assessment because caribou occur at higher elevation than project roads, so no vehicle-caribou collisions are expected. The Wildlife Accident Reporting System (WARS) database also does not have any records of caribou being killed on highways in the RSA.

The potential effect of increased indirect mortality (increased roads and hunting) was also scoped out of the assessment because no new roads will be constructed for the project that could provide access for hunters to new areas.

Table 13.6-7. Ranking Potential Effects On Wildlife and Wildlife Habitat

	Project Activities	Potential Effects on Wildlife and Wildlife Habitat					
		Habitat Loss and Alteration	Sensory Disturbance	Disruption to Movement	Direct and Indirect Mortality	Attractants	Chemical Hazards
Construction	**Underground Mine**						
	Construction of Production Decline (2 headings - surface and underground)	L	L	O	O	O	O
	Haul of waste rock from Production Decline portal to Shaft Site	L	L	O	O	O	O
	Ventilation during construction	O	O	O	O	O	O
	Development mining of underground service bays, sumps, conveyor headings, etc.	O	O	O	O	O	O
	Construct underground conveyor system	O	O	O	O	O	O
	Coal Processing Site						
	Surface Preparation						
	Establish site drainage and water management	L	L	L	L	O	L
	Site clearing and stripping (CPP site, CCR North)	M	M	L	L	O	O
	Soil salvage for reclamation	M	M	L	L	O	O
	Upgrade access roads, parking and laydown areas	M	M	L	L	O	O
	Heavy machinery use	L	M	L	L	O	O
	Buildings and Services						
	Install domestic water system	L	L	L	L	L	L
	Install sanitary sewer system	L	L	L	L	L	L
	Install natural gas and electricity distribution network	L	L	L	L	L	L
	Construct main fuel station	L	L	L	L	L	L
	Construct buildings (e.g., maintenance, administration, warehouse)	L	L	L	L	L	L
	Construct raw coal and clean coal stockpile areas	L	L	L	L	L	L
	Construct coal preparation plant buildings and install/commission equipment	L	L	L	L	L	L
	Construct surface conveyor system	L	L	L	L	L	L
	Construct rail load-out facilities	L	L	L	L	L	L
	Shaft Site						
	Upgrades to infrastructure within existing site	O	L	O	O	O	O
	Addition of waste rock within existing storage area	L	L	O	O	O	O
	Management of runoff from waste rock pile and release to receiving environment (M20 Creek)	M	O	O	O	L	M
	Decline Site						
	Upgrades to infrastructure within existing site	L	L	O	O	O	O
	Management of water from underground activities and release by exfiltration to ground	M	O	O	O	L	M
	Traffic and Transportation						
	Transportation of materials to and from site	O	L	L	L	O	O
	Recycling and solid waste disposal	O	O	O	O	M	M
	Shuttling workforce to and from site	O	L	L	L	O	O
	Workforce and Administration						
	Hiring and management of workforce	O	O	O	O	O	O
	Taxes, contracts, and purchases	O	O	O	O	O	O

(continued)

Table 13.6-7. Ranking Potential Effects On Wildlife and Wildlife Habitat (continued)

	Project Activities	Potential Effects on Wildlife and Wildlife Habitat					
		Habitat Loss and Alteration	Sensory Disturbance	Disruption to Movement	Direct and Indirect Mortality	Attractants	Chemical Hazards
Operations	**Underground Mine**						
	Longwall panel mining, and development mining	O	O	O	O	O	O
	Ventilation from underground	O	O	O	O	L	O
	Methane management	O	O	O	O	O	O
	Secondary shaft construction	L	L	O	O	O	O
	Underground seepage collection and water management	O	O	O	O	O	O
	Surface subsidence	M	O	M	O	O	O
	Coal Processing Site						
	Coal Processing Plant						
	Stockpiles of raw coal	O	L	L	O	O	L
	Operation of coal preparation plant and conveyor system	O	M	M	O	O	L
	Stockpiles of clean coal and middlings	O	L	L	O	O	L
	Operation of rail loadout	O	M	M	O	O	L
	CCR						
	CCR Pile development	O	L	L	O	O	L
	Site clearing and stripping (expansion of CCR North, construction of CCR South)	M	M	O	M	O	O
	Seepage collection system	O	O	O	O	O	O
	Water Management						
	Management of water brought to surface from underground	O	O	O	O	O	M
	Management of seepage from CCR	O	O	O	O	O	M
	Management of other site contact water	O	O	O	O	O	M
	Maintenance of site ditching and water management infrastructure	O	O	O	O	O	L
	Release of excess contact water to receiving environment	O	O	O	O	O	M
	Shaft Site						
	Maintenance of infrastructure within existing site	O	L	O	O	O	O
	Progressive reclamation of waste rock pile	O	O	O	O	O	O
	Management of runoff from waste rock pile and release to receiving environment (M20 Creek)	O	O	O	O	O	M
	Decline Site						
	Maintenance of infrastructure within existing site	O	L	O	O	O	O
	Secondary Shafts Site						
	Site preparation and construction of shafts	M	L	M	L	O	O
	Maintenance of infrastructure within existing site	O	L	O	O	O	O
	Utilities, Power, and Waste Handling						
	Electrical power use	O	O	O	O	O	O
	Natural gas use	O	O	O	O	O	O
	Domestic water use	O	O	O	O	O	O
	Domestic sewage handling	O	O	O	O	M	O
	Recycling and solid waste disposal	O	O	O	O	M	O

(continued)

Table 13.6-7. Ranking Potential Effects On Wildlife and Wildlife Habitat (completed)

	Project Activities	Potential Effects on Wildlife and Wildlife Habitat					
		Habitat Loss and Alteration	Sensory Disturbance	Disruption to Movement	Direct and Indirect Mortality	Attractants	Chemical Hazards
Operations (*cont'd*)	**Heavy Machinery, Traffic, and Transportation**						
	Shuttling workforce to and from site	L	M	M	M	O	O
	Transportation of materials to and from site	L	M	M	M	O	O
	Surface mobile equipment use	L	M	O	O	O	O
	Road maintenance	L	M	O	M	O	O
	Fuel storage	O	O	O	O	O	M
	Workforce and Administration						
	Hiring and management of workforce	O	O	O	O	O	O
	Taxes, contracts, and purchases	O	O	O	O	O	O
Decommissioning and Reclamation	**Infrastructure Removal and Site Reclamation**						
	Facility tear down and removal	L	L	O	O	O	O
	Reclamation of plant site	O	O	O	O	O	O
	Reclamation of on-site roads and rail lines	O	O	O	O	O	O
	Recycling and solid waste disposal	O	O	O	O	M	M
	Heavy Machinery, Traffic, and Transportation						
	Shuttling workforce to and from site	L	M	M	M	O	O
	Transportation of materials to and from site	L	M	M	M	O	O
	Surface mobile equipment use	L	M	O	O	O	O
	Fuel storage	O	O	O	O	O	M
	CCR						
	Reclamation of CCR	O	O	O	O	O	O
	Seepage collection system	O	O	O	O	M	M
	Site water management and discharge to receiving environment	O	O	O	O	M	M
	Underground Mine						
	Infrastructure tear down and removal	L	M	M	M	O	O
	Geotechnical and hydrogeological assessment and bulkhead installation	O	O	O	O	O	L
	Groundwater monitoring	O	O	O	O	O	O
	Workforce and Administration						
	Hiring and management of workforce	O	O	O	O	O	O
	Taxes, contracts, and purchases	O	O	O	O	O	O
Post Closure	**Shaft Site**						
	Waste rock pile seepage monitoring	O	O	O	O	O	O
	CCR						
	Seepage collection system	O	O	O	O	M	M
	Site water management and discharge to receiving environment	O	O	O	O	M	M
	Underground Mine						
	Groundwater monitoring	O	O	O	O	O	O

O *No interaction anticipated.*

L *Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; no monitoring required, no further consideration warranted.*

M *Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*

H *Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

The potential effect of attractants was scoped out of the assessment because caribou are not known to be attracted to industrial developments or camps, unlike other wildlife species such as bears or marten.

The potential effect of chemical hazards on caribou was also scoped out of this assessment in Section 13.6.3.6. The major pathway of chemical uptake in ungulates is from the ingestion of vegetation and soil. Predicted concentrations in soil had Hazard Quotients below 1.0 thus COPCs in soil were screened out of the assessment (Section 18.8.3.1). No vegetation specific guidelines for COPCs are available, however, the soil quality guidelines are considered to be protective against effects to vegetation or higher trophic level consumers. Since predicted soil concentrations are anticipated to be below an HQ of 1.0, uptake of COPCs from vegetation was also screened out of the assessment. While M19A Creek and the wetland habitat between the Coal Processing Site and the Murray River are anticipated to exceed water quality guidelines (for the protection of wildlife) for selenium, very little high-quality habitat for caribou was located in these areas. Caribou are anticipated to achieve the majority of their water intake needs through vegetation; thus COPC uptake from water was scoped out for caribou.

The potential residual effects considered in the assessment for caribou during Construction, Operation, Decommissioning and Reclamation, and Post Closure phases are summarized in Table 13.7-1, and described in Sections 13.7.1.1 to 13.7.1.5.

Table 13.7-1. Ranking Potential Effects on Caribou

Project Components/ Physical Activities	Potential Effects on Caribou					
	Habitat Loss and Alteration	Sensory Disturbance	Disruption of Movement	Direct and Indirect Mortality	Attractants	Chemical Hazards
Construction						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	L	L	L	O	O	O
Shaft Site	O	L	O	O	O	O
Decline Site	O	L	O	O	O	O
Traffic and Transportation	O	L	O	O	O	O
Operation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	L	L	L	O	O	O
Traffic and Transportation	O	L	O	O	O	O

(continued)

Table 13.7-1. Ranking Potential Effects on Caribou (completed)

Project Components/ Physical Activities	Potential Effects on Caribou					
	Habitat Loss and Alteration	Sensory Disturbance	Disruption of Movement	Direct and Indirect Mortality	Attractants	Chemical Hazards
Decommissioning and Reclamation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	L	O	O	O	O
Post-Closure						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	O	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	O	O	O	O	O

(-) *No spatial or temporal overlap.*

O *Spatial and temporal overlap, but no interaction anticipated; no further consideration warranted.*

L *Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; no monitoring required, no further consideration warranted.*

M *Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*

H *Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

13.7.1.1 Habitat Loss and Alteration

Caribou Habitat Requirements and Availability

Caribou habitat use requirements for forage and security elements vary between the seasons and life stages. Habitat selection by caribou in all seasons is a balance between forage availability, forage abundance, and forage quality with risk of predation (Jones *et al.* 2007).

The Quintette herd is known to use the alpine and subalpine extensively year-round. Jones et al. (2007) found that the Quintette herd selected for elevations greater than 1300 m and generally avoided pine- or spruce-leading forests as well as shrub, deciduous and young coniferous stands. They believed that predation risk from wolves might have been higher within these vegetation cover types. Selection for western and southern aspects and avoidance of steeper slopes and eastern and northern aspects was also documented in this study (Jones *et al.* 2007).

Winter

The winter diet of northern caribou primarily consists of terrestrial lichen. During poor snow conditions, when the energetic costs of cratering through deep or crusted snow are too high, arboreal lichens may also be consumed. Secondary forage may also include dwarf shrubs. Wintering areas where lichens are available include alpine tundra, subalpine forest, mid-elevation pine stands and wetlands. Different ecotypes and herds within ecotypes make use of different areas and exhibit differing winter migration patterns in response to predation risk, snow depths and snow density.

Caribou of the Quintette herd were found to primarily use alpine areas from early winter to spring (Jones et al. 2004, 2007). Concentration on windswept alpine ridges above 1700 m was typical. Within the RSA, Mount Spieker and Quintette/Babcock Mountains alpine complexes appear to be the most heavily used. Occasionally Mount Reesor and Fortress Mountain are also used (WCCC 2007a). Although most members of the Quintette herd remain in the alpine during the winter season, there have been a few documented cases of individual caribou moving to low elevation habitats (D. Seip, *pers. comm.*).

Growing Season

In the growing season, woodland caribou eat willow and birch leaves, other shrubs (e.g. mountain ash), Labrador tea and Vaccinium species. These species are abundant in subalpine meadows and moist high elevation forests. Jones et al. (2007) found that Quintette caribou selected for alpine or parkland areas during calving and summer/fall seasons. Use of low elevation forests in spring was not documented and may demonstrate an exchange of higher quality green forage for a lower risk of predation in alpine areas. Lower elevation forests on the eastern side of the Rockies, including within the RSA, may not be as productive and may support a higher number of ungulates (and therefore predators) than the wetter western side of the Rockies (Jones *et al.* 2007). During the summer and calving periods, the use of subalpine, fir-leading, high elevation habitat by the Quintette herd increases (WCCC 2007a). Sopuck (1985, in WCCC 2007a) also found that Quintette caribou used high elevation alpine and open subalpine habitats exclusively in summer and fall (WCCC 2007a).

Calving

The calving period for woodland caribou is generally the month of June. Calving tends to occur in subalpine krummholz (Sopuck 1985 in WCCC 2007a), parkland or alpine tundra areas. Sites selected for calving are high elevation as an anti-predator tactic. Pre-calving females may migrate between 10 and 40 km to calving grounds (Jones 2007). Calving areas used by the Quintette herd have been documented on Mount Reesor within the RSA and Mount Collier just west of the RSA and extending southwest to the Hominka drainage (of the Parsnip River watershed) (WCCC 2007a).

Critical Habitat Identified in the Federal Recovery Strategy

The federal Recovery Strategy for the Woodland Caribou, Southern Mountain Population (Environment Canada 2014), hereafter Recovery Strategy, has identified a suite of habitat characteristics that are required to support land use planning for woodland caribou. Southern mountain caribou of the Central group live in relatively shallow snow areas. They forage primarily on terrestrial lichens either in low elevation mature coniferous forests or on windswept alpine slopes

during winter. In summer they are mostly at higher elevations in the mountains. During winter, these caribou primarily dig through the snow to access terrestrial lichens, but they also forage on arboreal lichens in low elevation forests, forested wetlands, and in subalpine habitats, especially during times when snow conditions are less favorable for cratering. Many subpopulations travel long distances between winter and summer ranges, while others winter and summer within the same general area.

During spring and summer, southern mountain caribou are found mostly at high elevations (like the Quintette herd) although portions of some populations also use low elevation habitat. In spring and summer, southern mountain caribou eat a variety of forbs, grasses, lichen, fungi, and leaves of some shrubs (Environment Canada 2014 and references therein).

In addition to seasonal ranges within their annual range, southern mountain caribou also require matrix range. Type 1 matrix range consists of areas within a local population unit's (LPU) annual range that have not been delineated as summer or winter range. Type 1 matrix habitat may include seasonal migration areas (or portions of migration areas) and areas of lower use compared to delineated seasonal ranges. Type 2 matrix range consists of areas surrounding annual ranges where predator/prey dynamics influence predation within the subpopulation's annual range. Type 2 matrix range may also include areas of trace occurrences of caribou, dispersal zones between subpopulations, or dispersal zones between LPU's.

The function of Type 1 matrix range is to provide some forage, connectivity between seasonal ranges, security from human disturbance, and a low risk of predation. The reason for identifying Type 1 matrix range is that habitat connectivity within an annual range allows for seasonal movement among habitats that have the different resources needed to satisfy life history requirements. This allows caribou to respond to habitat disturbance or habitat recovery. Connectivity within annual ranges also allows for movement in response to changing environmental conditions (e.g., climate change).

Type 2 matrix range influences predator/prey dynamics within southern mountain caribou annual ranges and provides connectivity between subpopulations within and among LPUs. Recovery of southern mountain caribou requires that Type 2 matrix range be recognized and managed to maintain a low predation risk. Although caribou primarily use high elevation areas and/or habitat types where they are spatially separated from other prey and predators, the habitat/prey/predator dynamics at lower elevations, and in area adjacent to annual ranges, contribute to prey/predator dynamics and mortality on caribou within their annual ranges (Environment Canada 2014 and references therein). This is because predators move beyond valley bottoms and also use higher elevations, especially during summer and fall.

Type 2 matrix range provides connectivity between subpopulations within and among LPU's and thereby allows for immigration and emigration, which helps to maintain genetic diversity and the species' consequent resilience to environmental stressors (e.g., disease, severe weather) (Environment Canada 2014).

To summarize, features of southern mountain caribou seasonal and matrix range for the Central Group include the following.

1. High elevation summer range (e.g., spring, calving, summer, fall/rut):
   a. alpine areas;
   b. subalpine parkland; and
   c. subalpine forests.
2. Low elevation summer range (e.g., spring, calving, summer, fall/rut):
   a. not applicable.
3. High elevation winter range:
   a. windswept alpine slopes;
   b. subalpine parkland; and
   c. subalpine forests.
4. Low elevation winter range:
   a. low elevation forested habitats (pine, spruce, pine/spruce mixed stands, black spruce stands;
   b. wetlands; and
   c. forested wetlands.
5. Matrix Range (Type 1):
   a. low or mid elevation forested and unforested habitat; and
   b. may include high elevation alpine areas, subalpine parkland and subalpine forests.
6. Matrix Range (Type 2):
   a. low elevation forested and unforested habitats; and
   b. may include high elevation alpine areas, subalpine parkland, and subalpine forests.

Traditional Knowledge

Although current habitat use by the Quintette herd is primarily at high elevations year-round, traditional knowledge from local First Nations communities indicates that lower elevation forested habitats above and adjacent to the Murray River were historically important to woodland caribou. As the population recovers, low elevation habitats may once again be important to these caribou.

The time scale of this recovery, however, will be beyond the life of the Project and existing mitigation measures and reclamation plans are in place to ensure that low elevation forested habitats recover to an extent suitable to support the recovery of the Quintette LPU of the Central Group of southern mountain caribou. In addition, the actual footprint of the Project above ground in low-elevation forests is relatively small and the subsidence area will likely have changes in topography, but remain forested and functioning as low elevation habitat for caribou (Matrix Range), if and when the herd recovers. As a result, these low elevation areas were not considered further in this assessment.

Caribou Habitat Loss and Alteration

Habitat Loss and Alteration due to the Mine Site Assessment Footprint

None of the 19,236 ha of total high-quality Quintette herd caribou habitat identified in the RSA will be lost within the Mine Site Assessment Footprints, which includes 2,592 ha of winter living habitat, 5,146 ha of summer living habitat, and calving habitat (Table 13.7-2; Figures 13.7-1 and 13.7-2).

Table 13.7-2. High-quality Quintette Herd Caribou Habitat Loss and Alteration in the Project Mine Site Assessment Footprint

Season	Habitat Lost and Altered (ha)	Regional Study Area		Local Study Area	
		Total High-quality Habitat (ha)	High-quality Habitat Lost/ Altered (%)	Total High-quality Habitat (ha)	High-quality Habitat Lost/ Altered (%)
Winter Living Habitat	0.0	2,592	0	571	0
Growing Living Habitat	0.0	5,146	0	672	0
Total Habitat[1]	0.0	19,236	0	674	0

[1]*Total Habitat for Quintette herd caribou includes calving habitat in addition to winter and growing living habitat*

Habitat Loss or Alteration due to Subsidence

Subsidence was evaluated for potential effects of habitat alteration on caribou. It is unclear how caribou habitat quality will change within the zone of subsidence, and additional high-quality caribou habitat may be created as a result of the effects of subsidence on the terrain or, not all of the caribou habitat currently available may be lost or altered as a result of subsidence. Thus, the assessment assumes a worst-case scenario whereby calculations are based only on high-quality caribou habitat that may be lost as a result of subsidence, but this is potentially an overestimate of actual habitat loss or alteration.

Figure 13.7-3 illustrates the total high-quality habitat for the Quintette herd that may be altered within the 200 m buffered zone of the coal seam panels where the effect of subsidence is anticipated to occur. The relative risk of change to high-quality Quintette herd caribou habitat is depicted by the number of overlapping panels to be mined, based on the Project Description (Section 3.6), where high-quality habitat occurs (Table 13.7-3; Figure 13.7-3). The risk of change increases with the number of panels mined vertically. A total of 52 ha of total high-quality Quintette herd habitat (0.3% of total high-quality habitat available in the RSA, and 7.7% of that available in the LSA) may be potentially altered due to subsidence (Table 13.7-3).

Figure 13.7-1

Quintette Caribou: Winter Living Habitat Lost due to the Mine Site Assessment Footprint

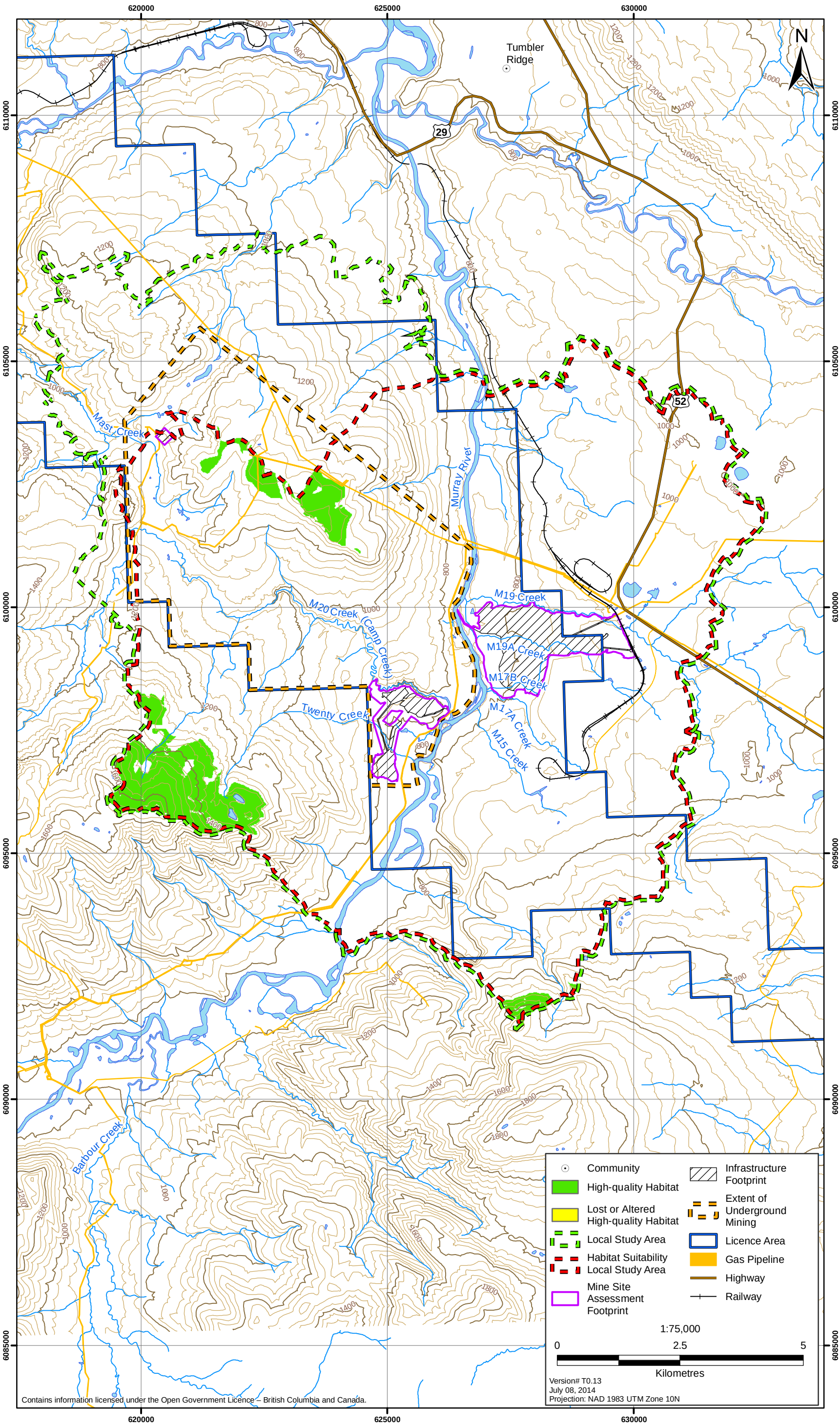


Figure 13.7-2

Quintette Caribou: Growing Living Habitat Lost due to the Mine Site Assessment Footprint

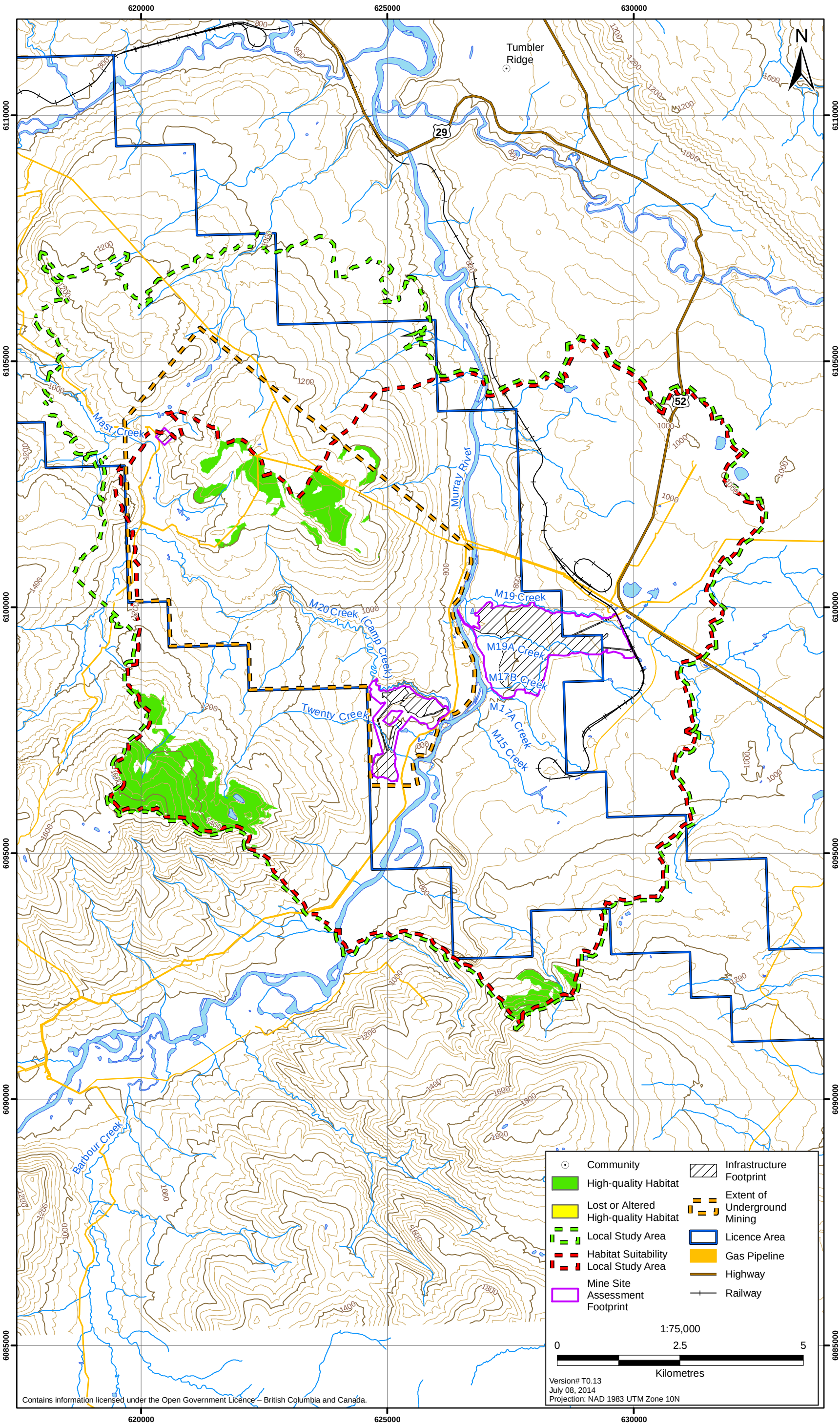


Figure 13.7-3
High-quality Quintette Caribou Habitat and Number of Overlapping Coal Seam Panels

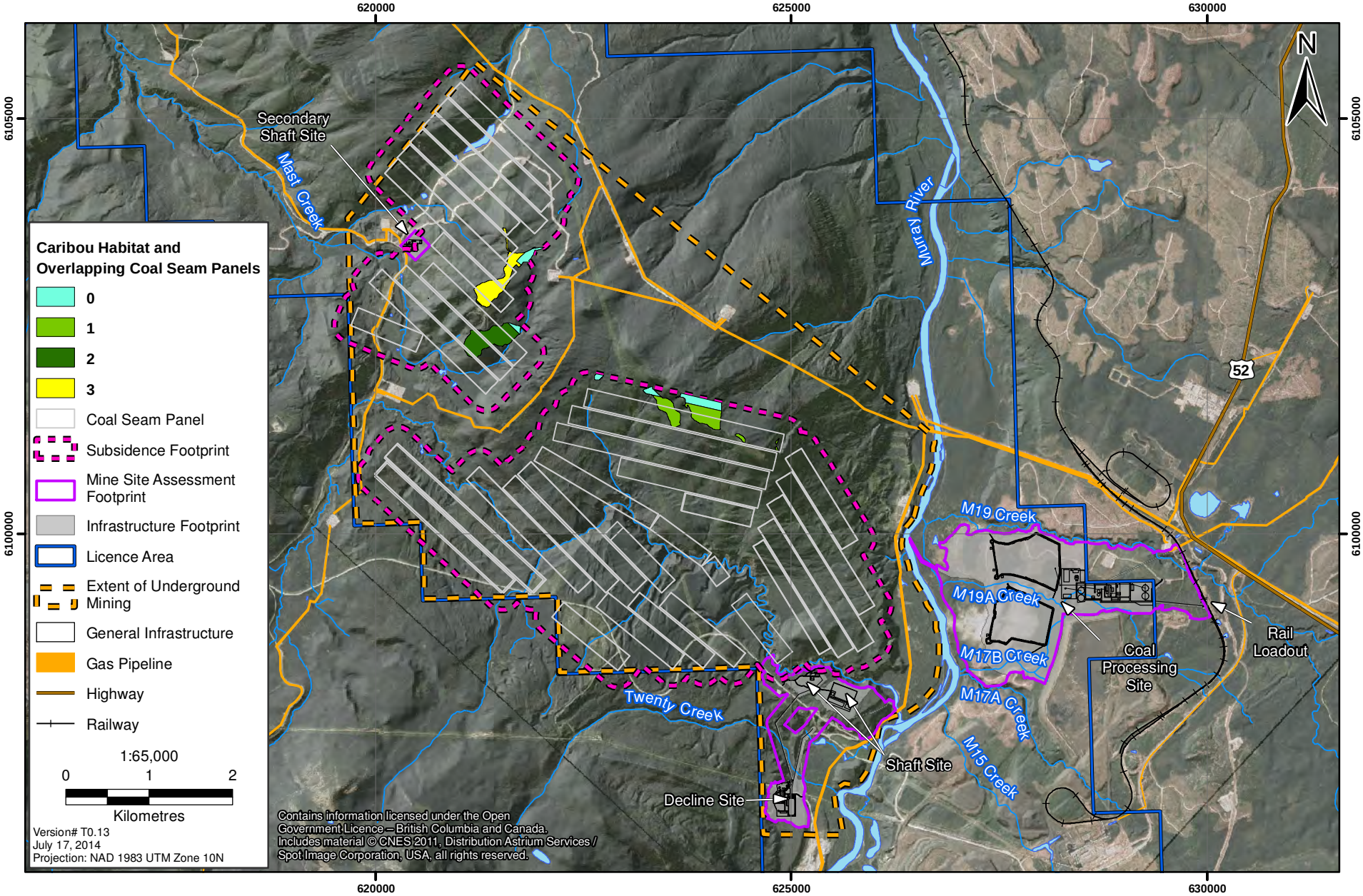


Table 13.7-3. High-quality Caribou Habitat Potentially Altered due to Subsidence

Season	Number of Panels Mined Vertically	Area of High-quality Habitat Potentially Altered (ha)	Regional Study Area		Local Study Area	
			Total High-quality Habitat (ha)	High-quality Habitat Altered (%)	Total High-quality Habitat (ha)	High-quality Habitat Altered (%)
	1	14				
	2	15				
	3	13				
	4	0				
	5	0				
Total Habitat	Total	52	19,236	0.3	674	7.7
Winter Living Habitat	Total	27	2,592	1.0	571	4.8
Growing Living Habitat	Total	52	5,146	1.0	672	7.8

Habitat loss or Alteration of Seasonal and Matrix Range as Identified in Recovery Strategy

Critical habitat identified in the Recovery Strategy is primarily located at high elevations, with the exception of some low elevation areas at the eastern portion of the LPU (and RSA). This distribution is consistent with habitat selection patterns documented by Jones et al. 2007 and Jones 2008, which formed the basis of the habitat suitability values used in this assessment. Matrix habitat is not delineated within the Quintette LPU by the Recovery Strategy, but is available in the neighboring Hart Ranges to the southwest. The Project LSA does not overlap with low or high elevation summer range, low or high elevation winter range, or Type 1 or Type 2 matrix habitat for the Quintette LPU as presented on page 78 of the Recovery Strategy. As a result, these broad habitat categories were not considered further in this assessment.

Residual Effects of Habitat Loss and Alteration for Caribou

Project related activities are not expected to directly remove or alter any high-quality caribou habitat. The amount of high-quality caribou habitat (winter and growing season) that may be affected (52 ha) in the area of subsidence is 0.3% of the total amount of caribou habitat available in the RSA, and 7.7% of the total amount of habitat available in the LSA. Much of the area in the subsidence zone may still be available to caribou, particularly after closure. As a result of negligible disturbance to high-quality caribou habitat, direct habitat loss in the Mine Site Assessment Footprints and alteration in the subsidence area is not predicted to result in a residual effect on caribou.

13.7.1.2 Sensory Disturbance

Mammal density has been shown to decrease up to 5 km away from industrial projects, with avoidance distances greater in open versus forested habitats (Benitez-Lopez, Alkemade, and Verweij 2010). Industrial activity can cause disturbance to wildlife that varies from short term (e.g., increased vigilance and short flight response) to long term. Long term chronic disturbance of ungulates can have several effects, including displacement of individuals or groups, earlier-than-usual migration, or changes in rates of movement (Van Dyke and Klein 1996). However, ungulates have shown the

capability to adapt to human presence when that presence is confined to predictable areas (R. Andersen, Linnell, and Langvatn 1996).

Three types of noise effects were evaluated for potential effects on caribou:

1. Project noise at the Mine Site Assessment Footprint = functionally lost
2. Vehicle noise along the access roads = degraded habitat
3. Train noise along the train route = low level disturbance

Noise modelling results were used to determine the area of caribou habitat that may be functionally lost or disturbed due to sensory disturbance during Construction and Operation. The total area of high-quality winter and growing season habitat that falls outside of the area of direct habitat loss and alteration due to the footprint (Section 13.7.1.1), but within the noise level contours of 45 dBA (for Project noise) and 75 dBA L_{AE} (road and rail traffic noise), was calculated.

Caribou Habitat Functionally Lost or Disturbed due to Noise

Continuous Project Noise: Of the 19,236 ha of high-quality Quintette herd caribou habitat identified within the RSA or the 674 ha identified in the LSA, none is predicted to be affected by Project noise during Construction and Operation (Table 13.7-4; Figure 13.7-4 and 13.7-5).

Instantaneous Vehicle Traffic Noise: None of the high-quality habitat identified for the Quintette herd in the RSA or LSA will be affected by elevated traffic noise levels (75 dBA Ln or greater) (Table 13.7-4).

Table 13.7-4. Functional Loss of High-quality Quintette Herd Habitat due to Sensory Disturbance during Construction and Operation

		Regional Study Area			Local Study Area		
Type of Sensory Disturbance	Project Phase	Total High-quality Habitat (ha)	High-quality Habitat Functionally Lost (ha)	% High-quality Habitat Lost in RSA	High-quality Habitat Available (ha)	High-quality Habitat Functionally Lost (ha)	% High-quality Habitat Lost in LSA
		19,236			674		
Continuous Project Noise (45 dBA)							
	Construction		0.0	0.0		0.0	0.0
	Operation		0.0	0.0		0.0	0.0
Instantaneous Traffic Noise(75 dBA)							
	Construction		0.0	0.0		0.0	0.0
	Operation		0.0	0.0		0.0	0.0
Instantaneous Train Noise (75 dBA)							
	Construction		-	-		-	-
	Operation		14.8	0.08		3.4	0.5

Figure 13.7-4

Quintette Caribou: Functional Habitat Loss of High-quality Habitat due to Noise - Construction

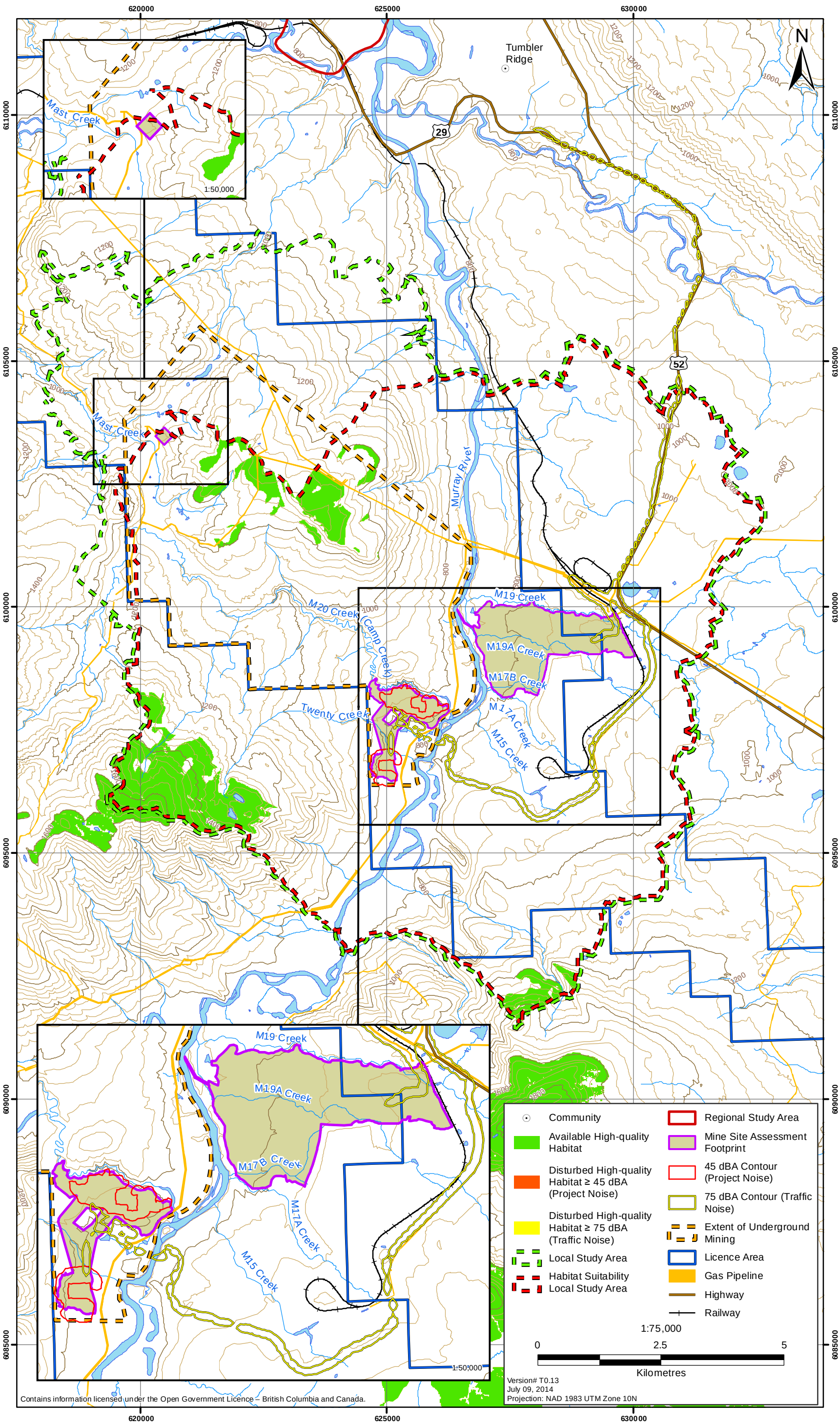
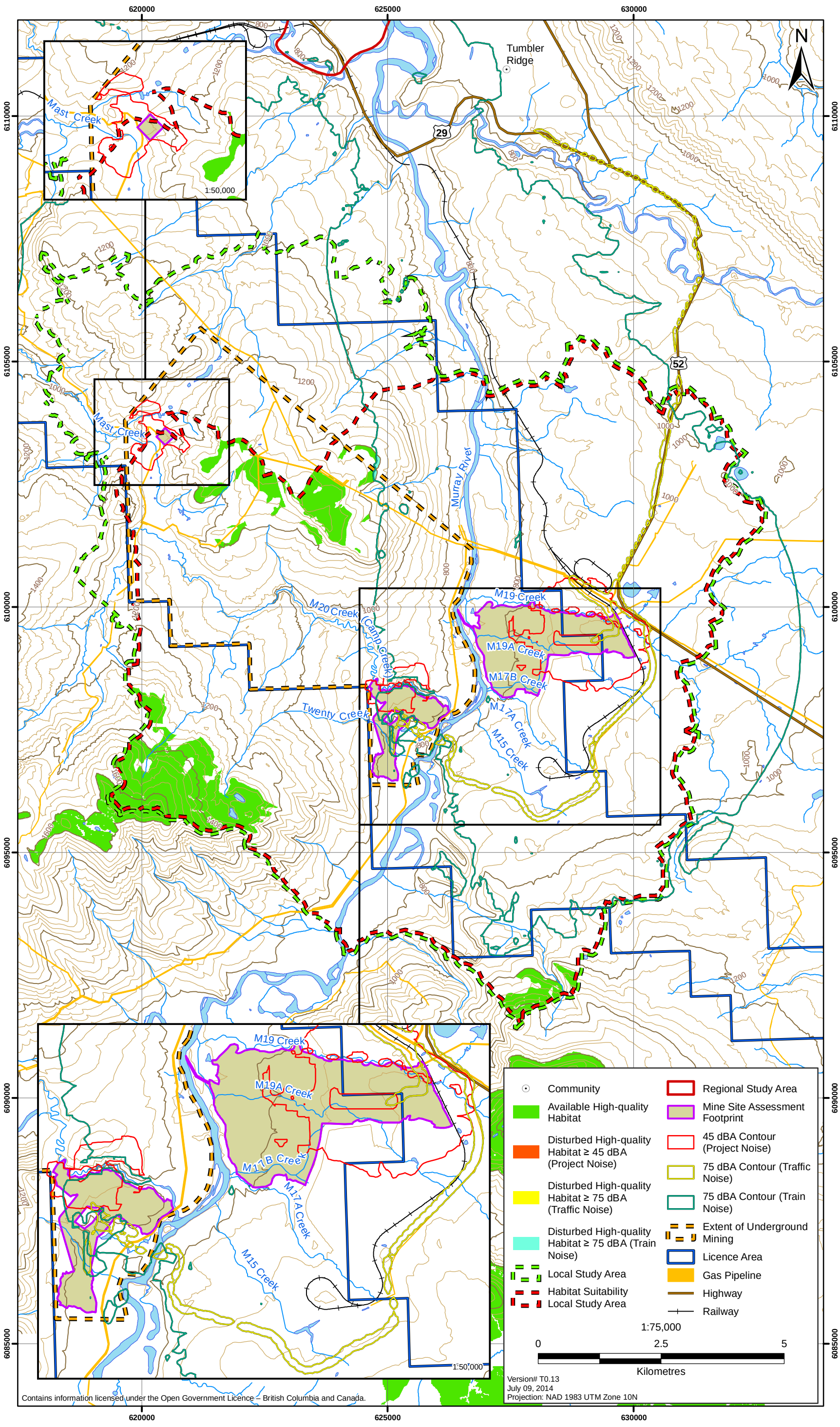


Figure 13.7-5

Quintette Caribou: Functional Habitat Loss of High-quality Habitat due to Noise - Operation



Instantaneous Train Noise: No Project-related trains are anticipated to run during Construction. During Operation, the total amount of high-quality Quintette herd caribou habitat affected by elevated train noise levels (75 dBA Ln or greater) after accounting for high-quality habitat lost due to habitat loss and alteration (Section 13.7.1.1) is 14.8 ha (0.08% of the high-quality habitat in the RSA). Of this total, 3.4 ha are disturbed in the LSA accounting for 0.5% of the high-quality Quintette herd caribou habitat in the LSA (Table 13.7-4 Figure 13.7-5).

Residual Effects of Sensory Disturbance for Caribou

Of the three types of noise evaluated for the Project, neither continuous noise at the Mine Site Assessment Footprint (functionally lost habitat) nor vehicle noise (degraded habitat) overlapped with any high-quality caribou habitat. Caribou habitat (14.8 ha) within elevated noise levels is only associated with rail noise, which was defined as having a low-level disturbance effect on most wildlife species (Section 13.6.3.2). This is because the noise from trains is a low frequency rumble paired with a fairly slow moving train, and is limited to two round trips lasting several minutes per day during Operation, and none during Construction. Due to the temporary nature of rail noise and the small amount of habitat affected, no residual effect of sensory disturbance on caribou is predicted.

13.7.1.3 Disruption of Movement

Given the lack of high-quality habitat in the Mine Site Assessment Footprints and their preference for high elevation areas year round, Quintette caribou are not expected to move through the Mine Site Assessment Footprints. Unlike other ungulates, Quintette caribou are not known to utilize the Murray River or Wolverine River valley as movement corridors. Telemetry data indicates that there is some movement of Quintette caribou from the high elevation ridges southwest of the license area between the Wolverine and Murray Rivers, and the Mount Babcock and Quintette Mountain area. HD Mining has contributed funding to support telemetry monitoring of the Quintette herd. Since 2002, 75,604 VHF and GPS telemetry locations have been recorded from 56 individuals of the Quintette herd. The resolution of the telemetry data (i.e., fixes every several hours to several days) preclude the delineation of specific movement corridors. However, of these locations, 16 individuals crossed the Murray River a total of 51 times, suggesting these low elevation movements are uncommon. These movements do not occur through the LSA, but rather tend to occur in an east – west direction across the Murray River at the southern portion of the RSA (Jones and Seip, 2012; D. Seip, BC MOE, PNCC meeting presentation on June 18, 2014). As a result, no residual effects associated with disruption to movement are anticipated on the Quintette caribou herd.

13.7.2 Mitigation Measures for Caribou

The Wildlife Management Plan (Section 24.12) describe the mitigation and management activities that are designed to reduce or eliminate potential effects to wildlife. Mitigation measures specific to caribou are described in the following sections.

13.7.2.1 Mitigation for Habitat Loss and Alteration

The effects of habitat loss and alteration on all wildlife, including caribou will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). Additional mitigation measures for habitat loss and alteration are detailed in Decommissioning and Reclamation (Section 3.9). The potential effects of subsidence will be monitored as per the Subsidence Management Plan (Section 24.15). Mitigation for direct habitat loss and alteration on caribou will include, but is not limited to:

- avoidance of important habitat where practical alternatives are available (e.g. habitat loss and alteration was minimized through Project design);
- Maintain known and potential mineral licks, should any be found for caribou, in a natural state and ensure ungulates have access to them during the season when they are most used; and
- re-vegetation of some reclaimed components during Decommissioning and Reclamation.

13.7.2.2 Mitigation for Sensory Disturbance

The effects of sensory disturbance on all wildlife, including caribou will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effects of sensory disturbance to caribou will be minimized by mitigating the effects noise (Section 24.3, Noise Management Plan). Guidelines will be followed to minimize the effects of noise on caribou and other wildlife (Milko 1998a; BC MOE 2006a).

The following noise mitigation measures will be implemented and are not limited to:

- noise specifications will be considered when selecting equipment to purchase;
- vehicles will be maintained regularly;
- speed limits will be imposed for on-site Project roads;
- mufflers will be installed on vehicles and maintained;
- noise dampening measures will be applied where possible; and
- noise will be monitored periodically at various human and wildlife receptor locations, as part of the Noise Management Plan (Section 24.3) and mitigation strategies will be adjusted accordingly, if required. Noise monitoring will occur at locations to enable confirmation of noise modelling and effects assessment.

13.7.2.3 Mitigation for Disruption of Movement

The effects of disruption to movement on all wildlife will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effect of disruption of movement will largely be mitigated by the same mitigation measures for habitat loss (Section 13.7.12.1). Additional mitigation measures for the disruption of movements for caribou will include but are not limited to:

- wildlife will be given the right-of-way along access roads and the highway; and
- enforcement of speed limits along on-site Project roads.

13.7.3 Key Effects on Moose

Moose were assessed for four potential Project-related effects. Habitat loss and alteration, sensory disturbance, disruption of movement, and direct mortality were considered for the effects assessment because those effects have the potential to interact with moose.

The potential effect of indirect mortality was scoped out of this assessment for moose. Indirect mortality can occur if new roads constructed for a project make a new area open to hunters. No new roads are planned for the Project that will provide new access for hunters and therefore no increase in the area available to hunters is expected.

The potential effect of attractants for moose was scoped out of this assessment. New project roads can also act as an attractant for moose, due to roadside salt, roadside vegetation and ease of movement. No new roads are planned for the Project and therefore no increase in attraction by moose to project facilities is expected.

The potential effect of chemical hazards on moose was scoped out of this assessment in Section 13.6.3.6. The major pathway of chemical uptake in ungulates is from the ingestion of vegetation and soil. Predicted concentrations in soil had HQs below 1.0 thus COPCs in soil were screened out of the assessment (Section 18.8.3.1). No vegetation specific guidelines for COPCs are available, however, the soil quality guidelines are considered to be protective against effects to vegetation or higher trophic level consumers. Since predicted soil concentrations are anticipated to be below an HQ of 1.0, uptake of COPCs from ingestion of vegetation were also screened out of the assessment. While M19A Creek and the wetland habitat between the Coal Processing Site and the Murray River are anticipated to exceed water quality guidelines (for the protection of wildlife) for selenium, and this wetland supports high-quality habitat for moose, ungulates are anticipated to achieve the majority of their water intake needs through vegetation; thus COPC uptake from water was scoped out for moose.

The potential residual effects considered in the assessment for moose during Construction, Operation, Decommissioning and Reclamation, and Post Closure phases are summarized in Table 13.7-5, and described in Sections 13.7.13.1 to 13.7.13.4.

Table 13.7-5. Ranking Potential Effects on Moose

Project Components/ Physical Activities	Potential Effects on Moose					
	Habitat Loss and Alteration	Sensory Disturbance	Disruption of Movement	Direct and Indirect Mortality	Attractants	Chemical Hazards
Construction						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	M	L	M	L	O	O
Shaft Site	O	L	O	O	O	O
Decline Site	O	L	O	O	O	O
Traffic and Transportation	O	L	L	L	O	O
Operation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	M	L	M	L	O	O
Traffic and Transportation	O	L	L	L	O	O
Decommissioning and Reclamation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	L	L	L	O	O
Post-Closure						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	O	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	O	O	L	O	O

- *No spatial or temporal overlap.*
- O *Spatial and temporal overlap, but no interaction anticipated; no further consideration warranted.*
- L *Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; no monitoring required, no further consideration warranted.*
- M *Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*
- H *Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

13.7.3.1 Habitat Loss and Alteration

Moose Habitat Requirements and Availability

Moose are generally browsers that eat the leaves and shoots of trees and shrubs, deciduous and coniferous leaves, and twigs year-round (Rea and Child 2007). Twigs are especially important in the winter months; however, if available, fallen leaves are preferred over twigs due to their higher nutritional value (Rea and Child 2007). The primary winter forage is willow; however, other winter forage species include red-osier dogwood, balsam poplar/black cottonwood, paper birch, trembling aspen, Saskatoon, highbush-cranberry, false box and subalpine fir. Bark stripping of aspen, willow, and balsam poplar also occurs in the winter (Rea and Child 2007). In late winter, forage may shift to coniferous trees such as subalpine fir as snow depth increases. Preferred growing season forage includes leaves of shrubs, herbs and aquatic vegetation such as horsetail, burweed, and submerged pondweed (Saxena and Bilyk 2000).

To access their preferred forage species, moose use a combination of both stable and transitory habitats. Stable habitats can be expected to provide shrubby browse over the long term and include high elevation shrub communities and riparian areas along watercourses. Transitory habitats are those areas of forest in early stages of regeneration due to having been disturbed by natural (e.g. fire, beaver activity) or human (e.g. timber harvesting, land clearing) activities, and therefore, can provide an abundance of shrubby and herbaceous forage until the stand reaches a more mature structural stage (Rea and Child 2007).

Winter

In the Peace Region, winter habitat tends to be in valley bottoms with shrubby areas and low to mid elevation forest stands in an early to mid-seral stage (Goulet and Haddow 1985 in Goddard 2003). Demarchi (2000) concluded that suitable winter habitat in the Peace Region occurs predominantly at elevations below 1,200 m with areas above 1,200 m supporting only very low population densities.

Preferred winter habitats include riparian and alluvial shrubby areas, burns, regenerating cutblocks and wetlands (Goddard 2003). Areas of gentle slopes, exposed southerly slopes with birch and willow and aspen stands and a favourable snow pack are preferred (Rea and Child 2007, Poole and Stuart-Smith 2006). Dense forest stands are also selected for shelter, food and predator avoidance (Coady 1974, Rea and Child 2007).

In winter, snow depths exceeding 70-100 cm restrict movements of moose as does wet, dense or crusted snow (Rea and Child 2007). Annual snowfall in the BWBSmw and BWBSwk1 is a range between 110 and 332 cm with averages of 156 cm and 241 cm respectively (Delong *et al.* 2011). In the SBSwk2, the annual snowfall ranges from 210 to 1,075 cm and averages 786 cm (Delong 2004). The ESSF can receive up to 220 cm of precipitation annually with 50-70% of this amount accumulating as snow. It is common for the maximum snowpack to range from 100 to 400 cm (Coupé *et al.* 1991).

Moose generally leave the ESSF during winter due to the deep snowpack, but are common in the BWBS and SBS. In particular, the BWBS is important overwintering habitat for ungulates (Meidinger and Pojar 1991, Goddard 2003). Most ideal habitats include both forage and shelter within close proximity to each other. For example, disturbed areas with regrowth of browse species, which are primarily shrubs of structural stage 3a and 3b, associated with nearby mature stands provide both

forage and cover (WCCC 2007b). In years of low snowfall accumulations, moose that utilize mid-elevations in mountainous areas or subalpine habitats in the summer months may remain in these areas during the winter (Rea and Child 2007, Goddard 2003). During winter, moose are most likely to be found within the BWBS and SBS biogeoclimatic zones, while the ESSF may provide less suitable winter habitat as suggested by a number of studies in the Peace Region (Goddard 2003).

Growing Season

Moose are less limited in the growing season (spring, summer and fall) and their habitat covers a broader area than winter. Moose summer habitat typically includes shrublands and riparian areas. Some moose move upslope to alpine fir thickets, while others may remain in valley bottoms year round (Rea and Child 2007). Wetlands, beaver ponds and lakes are often visited in the growing season to access aquatic vegetation (Rea and Child 2007).

Moose Habitat Loss and Alteration

Habitat loss and alteration were evaluated for the Project. Habitat loss and alteration will occur in the Mine Site Assessment Footprints, where forested and wetland areas will be converted for use for Project infrastructure, and alteration of habitat is discussed in the area where subsidence will occur due to underground mining.

Habitat Loss and Alteration due to the Mine Site Assessment Footprint

A total of 24,847 ha of high-quality moose habitat was identified in the RSA. Habitat loss due to development of project facilities will primarily occur where there are riparian and mature stands of forests adjacent to the Murray River, in relatively low elevation areas. This will result in the loss of 394 ha of high-quality moose habitat in the Mine Site Assessment Footprints. This is equivalent to 1.6% of the total high-quality moose habitat (all seasons combined) available within the RSA, or 7% of that available in the LSA (Table 13.7-6).

Table 13.7-6. Moose High-quality Habitat Loss and Alteration due to the Project Mine Site Assessment Footprint

		Regional Study Area		Local Study Area	
Season	High-quality Habitat Lost and Altered (ha)	Total High-quality Habitat (ha)	High-quality Habitat Lost/Altered (%)	Total High-quality Habitat (ha)	Habitat Lost/Altered (%)
Moose Winter Living Habitat	334	19,228	1.7	3,747	8.9
Moose Growing Living Habitat	237	20,366	1.2	3,795	6.2
Total Moose Habitat	394	24,847	1.6	5,624	7.0

A fractionally greater percentage of habitat loss will occur for the winter living season habitat (1.7% of high-quality habitat in the RSA and 8.9% of the high-quality habitat in the LSA) relative to the percentage of growing living habitat lost (1.2% of high-quality living habitat available in the RSA, and 6.2% of that available in the LSA) as a result of development of mine infrastructure within the Mine Site Assessment Footprints (Table 13.7-6; Figures 13.7-6 and 13.7-7).

Figure 13.7-6

Moose: Winter Living Habitat Lost due to the Mine Site Assessment Footprint

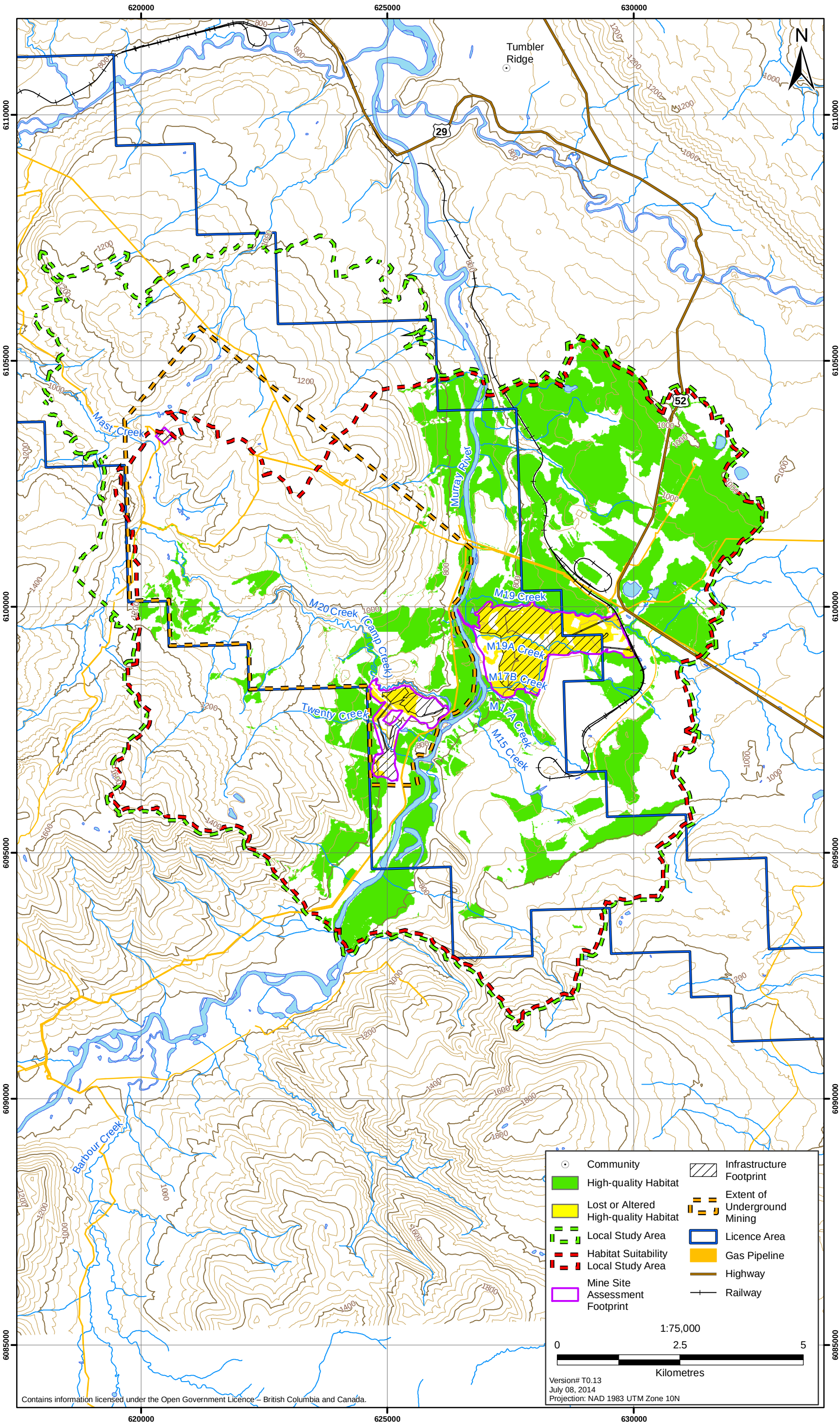
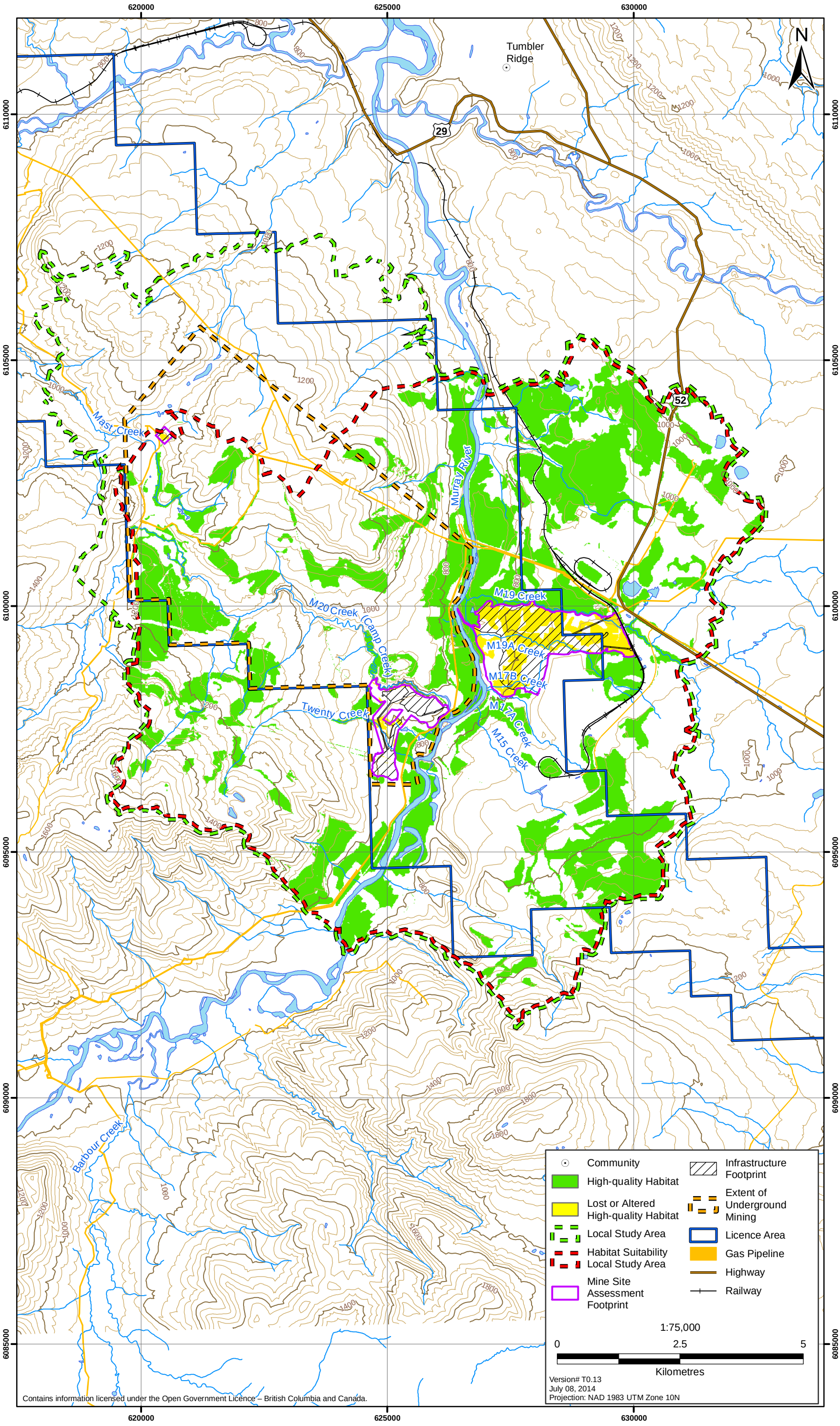


Figure 13.7-7

Moose: Growing Living Habitat Lost due to the Mine Site Assessment Footprint



Habitat Loss or Alteration due to Subsidence

In addition to direct habitat lost in the Mine Site Assessment Footprint, a total of 561 ha of high-quality moose habitat (2.3% of total high-quality habitat available in the RSA and 10.0% of that available in the LSA) may be altered due to subsidence (Table 13.7-7). Figure 13.7-8 illustrates the total high-quality moose habitat that may be altered within a 200 m buffer zone of the coal seam panels where the effect of subsidence is anticipated to occur. The relative risk to high-quality moose habitat is determined by the number of underground panels to be mined, as outlined in the Project Description (Section 3.6), and thus the amount of subsidence (Table 13.7-7; Figure 13.7-8). Areas with more panels being mined vertically are anticipated to experience the greatest subsidence.

Table 13.7-7. High-quality Moose Habitat Potentially Altered due to Subsidence

			Regional Study Area		Local Study Area	
Season	Number of Panels Mined Vertically	Area of High-quality Habitat Potentially Altered (ha)	Total High-quality Habitat[1] (ha)	High-quality Habitat Altered (%)	Total High-quality Habitat[1] (ha)	High-quality Habitat Altered (%)
Total Moose Habitat						
	1	87				
	2	93				
	3	123				
	4	38				
	5	120				
	Total[1]	561	24,847	2.3	5,624	10.0
Moose Winter Living Habitat	Total[1]	247	19,228	1.3	3,747	6.6
Moose Growing Living Habitat	Total[1]	450	20,366	2.2	3,795	11.9

[1]*Total includes area within the 200 m buffer where all subsidence may occur*

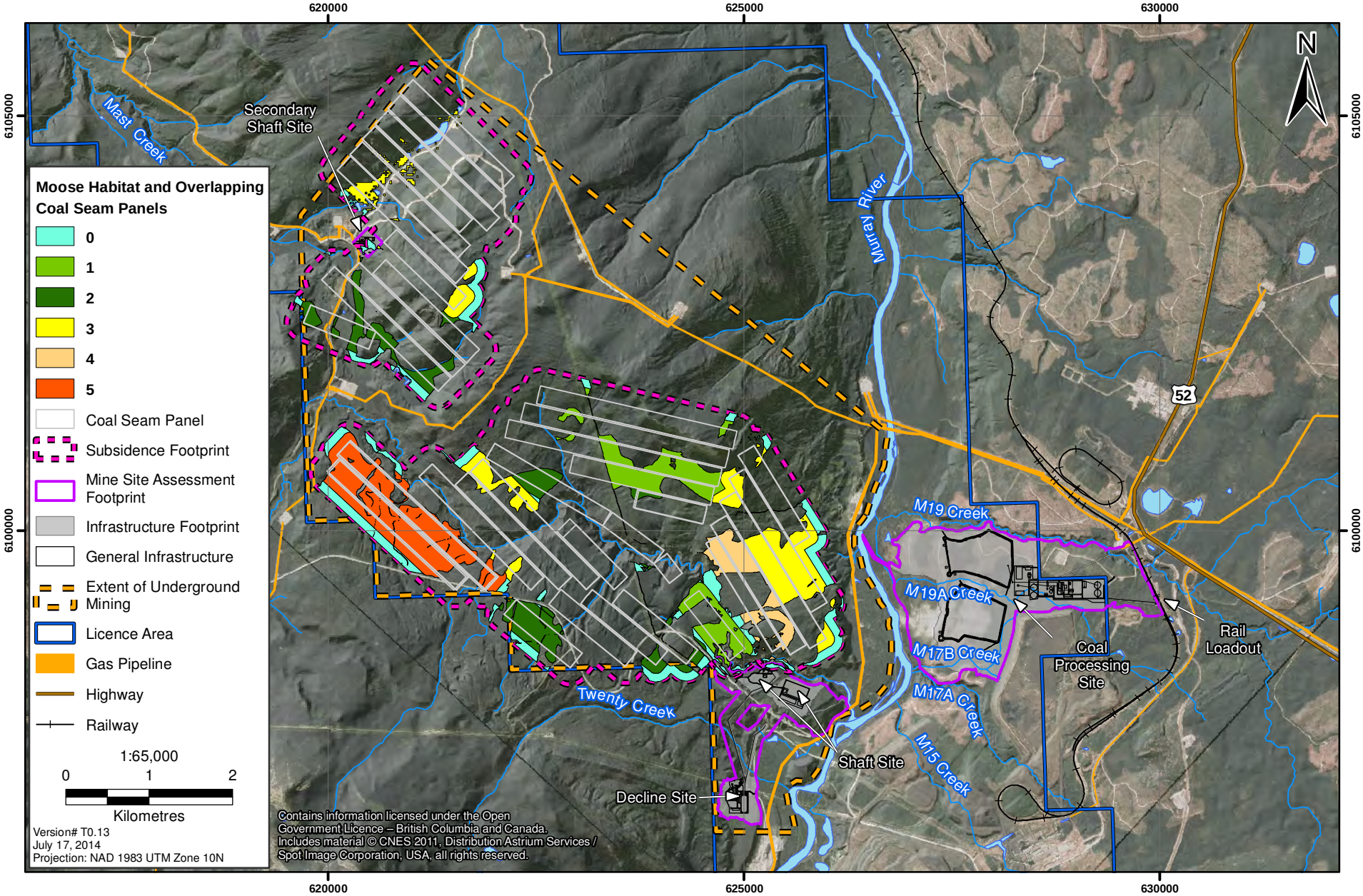
It is unclear how habitat quality for moose will change within the zone of subsidence. Some additional high-quality habitat may be created for moose during some seasons as a result of the effects of subsidence on the terrain (e.g., increased wetlands), and not all high-quality moose habitat within this area may be lost or altered. The assessment assumes a worst-case scenario whereby all high-quality moose habitat is altered to produce lower quality habitat within the subsidence area. This is likely an overestimate of actual habitat loss or alteration.

Residual Effects of Habitat Loss and Alteration on Moose

Direct habitat loss in the Mine Site Assessment Footprints and alteration in the subsidence area is predicted to result in a residual effect on moose. The amount of high-quality moose habitat (winter and growing season) that will be affected (394 ha) in the Mine Site Assessment Footprints is 1.6% of the total amount of moose habitat available in the RSA, and 7% of the total amount of habitat available in the LSA.

The density of moose observed in the census area of the interior portion of the RSA was estimated at 0.3 moose per km^2 (Rowe 2008). (or 0.0030 moose per hectare); therefore, the loss of 394 ha of habitat may affect 1.12 moose, assuming a uniform density across WMU-7-21.

Figure 13.7-8
High-quality Moose Habitat and Number of Overlapping Coal Seam Panels



Habitat alteration by subsidence could affect 561 ha of high-quality moose habitat, equating to the potential displacement of 1.68 moose (based on a density of 0.0030 moose per ha) if maximum subsidence occurs in the subsidence area and no moose habitat is created.

The combination of moose habitat lost in the Mine Site Assessment Footprints and altered in the subsidence area will likely result in a residual effect on moose. This is a conservative determination because the combination of habitat loss and alteration is anticipated to result in the loss of approximately 1% of a moose's range. Assuming overlapping ranges, the home range of approximately 2.7 moose would be affected by the combination of habitat loss and alteration, each to approximately 1% of their range.

13.7.3.2 Sensory Disturbance

Noise will likely result in some functional loss of habitat due to avoidance of Project areas by wildlife. Mammal density has been shown to decrease up to 5 km away from large industrial projects, with avoidance distances greater in open versus forested habitats (Benitez-Lopez, Alkemade, and Verweij 2010). However, ungulates have shown the capability to adapt to human presence when that presence is confined to predictable areas (R. Andersen, Linnell, and Langvatn 1996).

Three types of noise effects were evaluated for potential effects on moose:

1. Project noise at the Mine Site Assessment Footprint = functionally lost
2. Vehicle noise along the access roads = degraded habitat
3. Train noise along the train route = low level disturbance

Noise modelling results were used to determine the area of moose habitat that may be functionally lost or disturbed due to sensory disturbance during Construction and Operation. The total area of high-quality winter and growing season habitat that falls outside of the area of direct habitat loss and alteration due to the footprint (Section 13.7.3.1), but within the noise level contours of 45 dBA (for Project noise) and 75 dBA L_{AE} (road and rail traffic noise), was calculated.

<u>Moose Habitat Functionally Lost or Disturbed due to Noise</u>

Noise from continuous Project noise and traffic noise will affect small areas of moose habitat in the RSA. Vibrational noise from the movement of trains will affect larger areas of the RSA.

Continuous Project Noise: Of the 24,847 ha of high-quality moose habitat identified within the RSA, a total of 7.8 ha will be affected by Project noise (greater than 45 dBA) during Construction outside of the Mine Site Assessment Footprint (Section 13.7.3.1). This is equivalent to 0.03% of the total high-quality moose habitat within the RSA or 0.1% of the high-quality moose habitat available within the LSA (Table 13.7-8; Figure 13.7-9).

During Operation, the total amount of high-quality moose habitat affected by Project noise is predicted to be 157 ha. This is equivalent to 0.6% of the high-quality moose habitat within the RSA and 2.8% of that within the LSA (Table 13.7-8; Figure 13.7-10).

Table 13.7-8. Functional Loss of High-quality Moose Habitat due to Sensory Disturbance during Construction and Operation

Type of Sensory Disturbance	Project Phase	Regional Study Area			Local Study Area		
		Total High-quality Habitat (ha)	High-quality Habitat Functionally Lost (ha)	% High-quality Habitat Lost in RSA	High-quality Habitat Available (ha)	High-quality Habitat Functionally Lost (ha)	% High-quality Habitat Lost in LSA
		24,847			5,624		
Continuous Project Noise (45 dBA)							
	Construction		8	0.03		8	0.1
	Operation		157	0.6		157	2.8
Instantaneous Traffic Noise(75 dBA)							
	Construction		41	0.2		40	0.7
	Operation		29	0.1		28	0.5
Instantaneous Train Noise (75 dBA)							
	Construction		-	-		-	-
	Operation		6,335	25.5		3,313	58.9

Instantaneous Vehicle Traffic Noise: The total amount of high-quality moose habitat affected by traffic noise (75 dBA Ln or greater) during Construction, in addition to habitat lost or altered to clearing activities (Section 13.7.3.1) and functionally lost to continuous Project noise, is 41.1 ha in the RSA and 39.9 ha in the LSA. This is equivalent to 0.2% of the high-quality habitat available in the RSA and 0.7% of that available in the LSA (Table 13.7-8; Figure 13.7-9).

During Operation (Table 13.7-8; Figure 13.7-10), 29.3 ha of high-quality habitat will be affected in the RSA (0.1% of high-quality habitat available in the RSA), and 28.1 ha in the LSA (0.5% of that available in the LSA).

Instantaneous Train Noise: No Project-related trains are anticipated to run during Construction. During Operation, the total amount of high-quality moose habitat affected by train noise levels (75 dBA Ln or greater), in addition to high-quality habitat lost to clearing activities, (Section 13.7.3.1), and functionally lost to continuous Project noise and instantaneous traffic noise, is 6,335 ha (25.5% of the high-quality habitat in the RSA) of which 3,313 ha are disturbed in the LSA accounting for 58.9% of the high-quality moose habitat in the LSA (Table 13.7-8; Figure 13.7-10). Train disturbance will be short-lived as only two round-trips per day are expected to transport coal from the rail load-out.

Residual Effects of Sensory Disturbance for Moose

Of the three types of noise evaluated for the Project, continuous noise at the Mine Site Assessment Footprint was considered functionally lost habitat and comprised 157 ha (0.6%) of high-quality habitat for moose in the RSA. Noise due to vehicles was considered degraded habitat and equaled 29 ha during operations, or 0.1% of high-quality moose habitat in the RSA. Finally, train noise was evaluated as low-level disturbance to moose and covered 6,335 ha (25%) of high-quality habitat. The train has been in operation for the past 30 years without any detectible effects on the moose population in the RSA, which is a healthy population (Rowe 2006). As a consequence, no residual effect is predicted for the effects of sensory disturbance on moose. However, the potential for noise to affect movement of moose along the Murray River is evaluated in Section 13.7.3.3.

Figure 13.7-9

Moose: Functional Habitat Loss of High-quality Habitat due to Noise - Construction

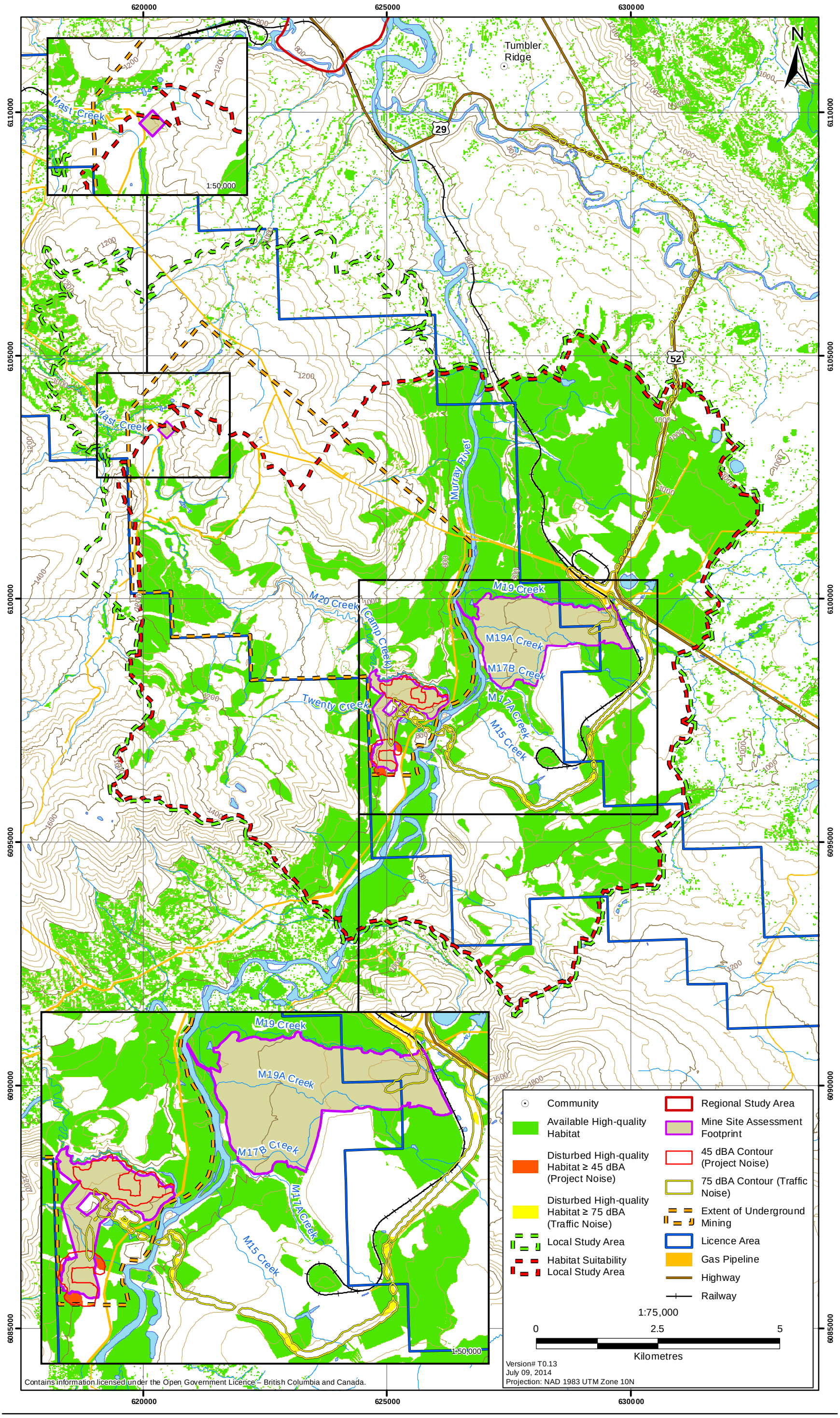
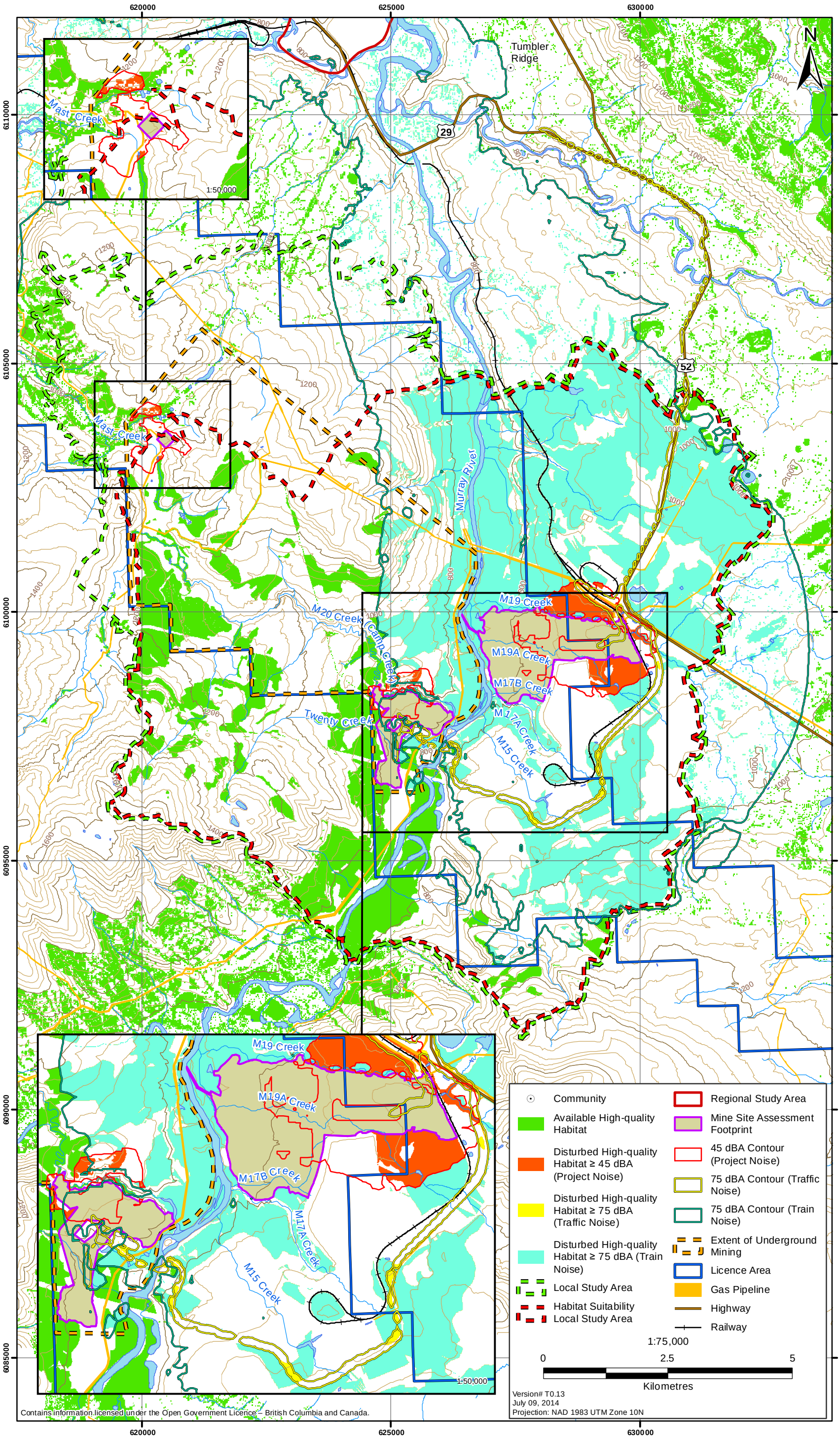


Figure 13.7-10

Moose: Functional Habitat Loss of High-quality Habitat due to Noise - Operation



13.7.3.3 Disruption of Movement

Disruption of movement for moose was evaluated for potential effects due to disturbance from traffic along access roads and from infrastructure along valleys. Moose in the foothills area of the Peace Region migrate between high elevation summer habitats and lower elevation winter habitats (Goddard 2003, WCCC 2010). However, very high elevation areas such as Alpine Tundra (as high as 1,500 m, Goddard 2003), are generally avoided due to the lack vegetation and tree cover (Rea and Child 2007). All biogeoclimatic units that occur in the RSA contain suitable habitat, and depending on season, all of the elevational ranges exhibited in the RSA are suitable habitat unless there is an existing habitat limitation, such as lack of suitable forage and vegetation, human activity, or deep snowpack (Rea and Child 2007). Migratory movements often follow traditional routes, using the same migration corridor every year, but patterns of migration may vary from year to year, depending on extent and duration of snowfall (Bowyer, Ballenberghe, and Kie 2003).

Two potential effects were evaluated for disruption of movement for moose: the effects of linear corridors such as roads, and the effects of infrastructure and subsidence as physical barriers to movements in the Murray and Wolverine valleys. The Murray and Wolverine valleys and their tributaries all contain high-quality habitat for moose, including suitable habitat for winter and the growing season (spring, summer and fall) at mid elevations in these drainages. These valley systems are connected together and likely facilitate moose movement between seasonal ranges within the RSA. Moose have been observed in each of these areas during aerial surveys and incidentally during other baseline fieldwork (Appendix 13-A). Recent collar data is unavailable, but this assessment assumes the Murray and Wolverine Valleys as potential movement corridors for moose given the prevalence of high value habitat.

The effects of the use of Project access roads in the Murray River Valley on moose are likely to be related primarily to both the physical presence of vehicles and humans and to the presence of the road itself (Beazley et al. 2004; Beazley et al. 2005). During winter, the ploughed access roads will provide relatively effective and energy efficient means of travel for moose; however, the presence of moose along the road will increase the risk of moose vehicle-related interactions (Section 13.7.3.4, Direct Mortality). Planned mitigation measures include the ploughing of refuge areas and the inclusion of gaps at regular intervals along the barriers and earth berms to provide escape routes for moose (Wildlife and Wildlife Habitat Management Plan, Section 24.12). Furthermore, roads may act as insurmountable barriers if traffic volumes exceed 10,000 vehicles/day (Seiler 2005). Traffic volumes due to the Project along the access road will be substantially lower, at 19 (Construction) and 12 (Operation) vehicles per day. Therefore, traffic is not anticipated to act as a complete barrier to movement for moose. However, the presence of the road and low traffic volume may still act as a partial barrier to movement for moose.

Planned Project facilities to be constructed in the Mine Site Assessment Areas will be constructed on both the east and west sides of the Murray River Valley. Development on the east of the Murray River will be adjacent to an extensive area of existing disturbance. This development will generate operational noise and the increased human activity may deter moose from moving through this portion of the valley. The Project will result in some areas of subsidence on the west side of the Murray River. The underground mining activities on the west side of Murray River introduce some

new disturbance in an area of minimal activity, potentially constricting the movement corridor through this area. Assuming a worst case scenario, the area of subsidence will affect approximately 561 ha of high-quality moose habitat (Figures 13.7-9 and 13.7-10; Table 13.7-8). This area of lost habitat on the west side of the river may disrupt north-south movement of moose along the Murray River valley.

The presence of some moderate and higher value habitat in the areas adjacent to Mast Creek and M20 Creek may additionally facilitate some elevational movements by moose between the Murray River corridor and sub-alpine areas. These creeks are found within the area of subsidence, and the potential effects of subsidence on these creeks and subsequent movement patterns are uncertain. The Wolverine River valley provides good distribution of moderate and high value moose habitat. Increased rail traffic in this valley may act as a deterrent from utilizing areas along this corridor, at least on an intermittent basis.

The Murray River valley functions as a movement corridor for moose (and other wildlife), and the Murray River Resource Management Zone was delineated in the Dawson Creek LRMP in part to maintain this function. The presence of high quality moose habitat in the RMZ facilitates movement through the area. A total of 3,033 ha of high quality moose habitat occurs within the portion of the RMZ that lies within the RSA boundary, with an approximately equal amount of winter and growing season habitat (Table 13.7.-9, Figure 13.7-11). Similarly, high quality winter (1,331 ha) and growing season (1,174 ha) habitat is evenly distributed in the portion of the RMZ that lies within the LSA extent. When accounting for all types of disturbance, approximately 10% and 6% of available winter and growing season habitat in the Murray River RMZ portion of the RSA will potentially be affected. In the LSA, approximately 20% and 14% of available high quality winter and growing season habitat in this portion of the RMZ may potentially be affected by collective disturbances.

Residual Effects of Disruption to Movement on Moose

Despite mitigation presented in Section 13.7.4.3, the effect of disruption of movement is predicted to result in a residual effect on moose due a combination of roads, traffic, and new development on the east side of the Murray River. The presence of infrastructure and subsidence near the Murray River, and rail traffic through the Wolverine River valley are expected to disrupt and partially limit moose movement through these areas.

13.7.3.4 Direct Mortality

Direct mortality of moose was evaluated for the Project because mortality can occur due to vehicle collisions in areas where roads used by the Project overlap high-quality moose habitat. Direct mortality of moose caused by vehicle collisions may occur during the proposed Project Construction, Operation, and Decommissioning and Reclamation phases along Project roads including the access road, Forest Service Roads, as well as along Highway 52.

Figure 13.7-11

High-quality Moose Habitat Lost, Altered, or Disturbed within the Murray River Resource Management Zone Corridor

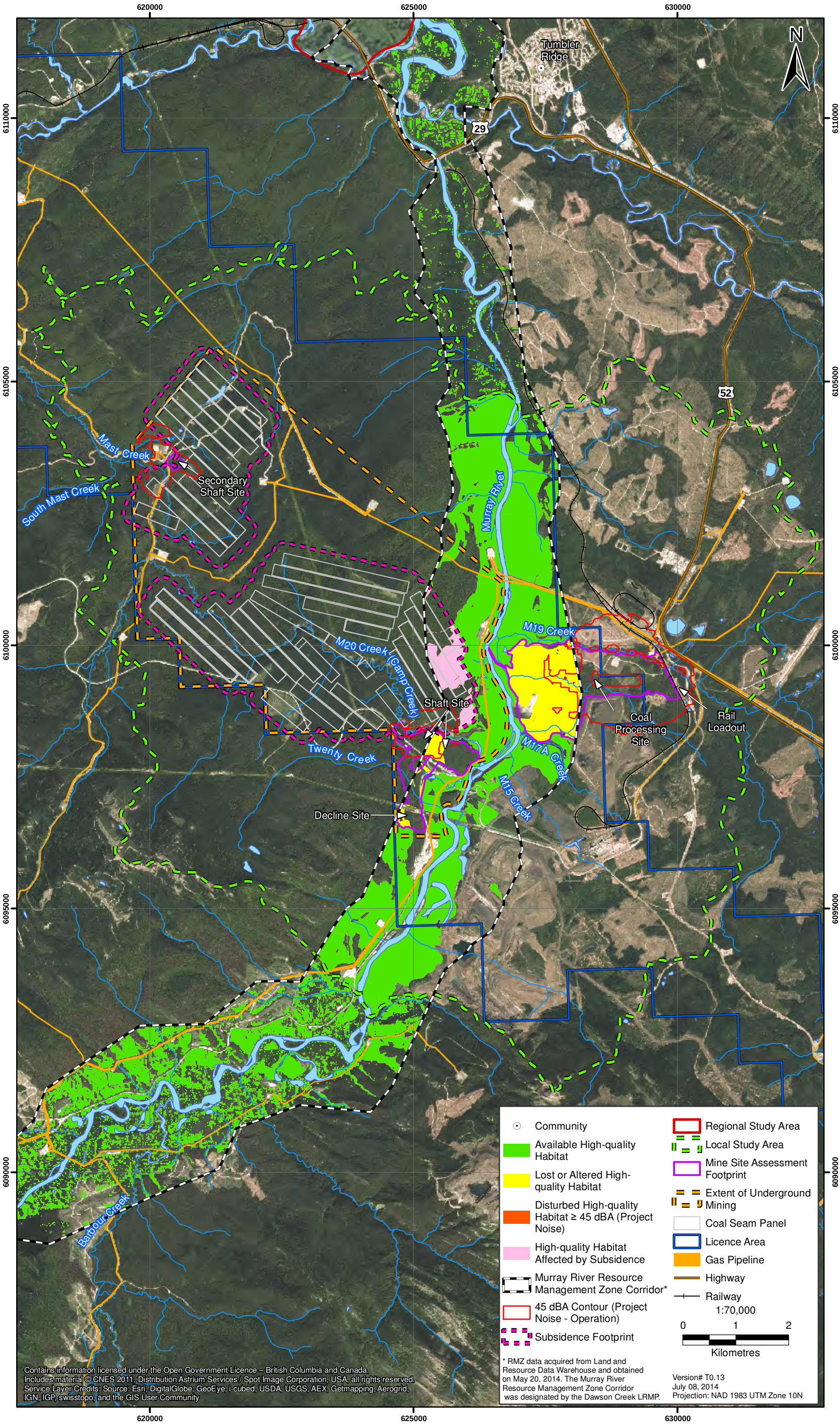


Table 13.7-9. High-quality Moose Habitat Lost, Altered, or Disturbed within the Murray River Resource Management Zone Corridor

Type of Habitat Alteration	Life History Phase	Murray River Corridor (within Regional Study Area)			Murray River Corridor (within Local Study Area)		
		High-quality Habitat Available (ha)	High-quality Habitat Lost/ Altered (ha)	% High-quality Habitat Lost/ Altered	High-quality Habitat Available (ha)	High-quality Habitat Lost/ Altered (ha)	% High-quality Habitat Lost/ Altered
Total High-quality Habitat within RMZ		3,033			1,727		
Winter High-quality Habitat within RMZ		2,574			1,331		
Growing High-quality Habitat within RMZ		2,479			1,174		
Habitat Loss due to Mine Site Assessment Footprint							
	Winter		199	7.7		199	14.9
	Growing		131	5.3		131	11.2
	Total		226	7.5		226	13.1
Habitat Alteration due to Subsidence							
	Winter		59	2.3		59	4.5
	Growing		28	1.2		28	2.4
	Total		71	2.4		71	4.1
Habitat Disturbance due to Continuous Project Noise (45 dBA)							
	Winter		0.4	0.02		0.4	0.03
	Growing		0.5	0.02		0.5	0.04
	Total		0.5	0.02		0.5	0.03

All habitat loss and alteration calculations are for end of Operation when the largest amount of habitat is anticipated to be lost or altered.
All noise disturbance calculations are during Operation when continuous Project noise will occur for the longest time period.

In general, vehicle-moose collisions tend to be aggregated in both time and space. Temporal patterns include changing food availability, seasonal migrations, and snow cover, while spatial factors include location of preferred foraging habitat, landscape topography, and road and traffic characteristics. Increased collision risk with animals is also associated with linear landscape features that funnel animals alongside or across roads, such as riparian corridors, transmission lines, and steep slopes and ridges, and with moose density (Seiler 2005).

During the growing season (spring, summer, and fall), moose may frequent edge habitats, such as road verges, because they contain high-quality forage and provide easy movement. During the winter, access roads will require snow removal. Moose tend to preferentially use ploughed roads when the winter snowpack is deep. High snow banks of 60 cm or more (Peek et al. 1982) can trap moose on access roads, putting them at greater risk of vehicle strikes. At relatively low traffic densities, increases in traffic are predicted to increase the number of moose mortality from vehicle strikes (Seiler 2005). For example, in Norway, moose vehicle collisions increased from 0.07 moose per 10 km of road in 1977 to 0.19 moose per 10 km of road in 2007 while traffic increased by 1.9 times during the same time period (Rolandsen et al. 2011).

Vehicle-moose collisions occur throughout the species range and are highlighted as a problem from both wildlife management and traffic safety perspectives (Sielecki 2004a; R. V. Rea et al. 2006). Evidence suggests that vehicle-moose collisions are less severe when speed limits are below 70 km/hr (Lavsund and Sandergren 1991).

In BC, information on wildlife collisions are stored in the Wildlife Accident Reporting System (WARS). These data likely under-represent the actual number of wildlife collisions, mainly due to reporting error; these numbers must be interpreted with caution, but they are the best available data. In the Peace District (District 8), there were 10 moose mortalities in 2012, or 0.04 moose/km/year.

It is estimated that the wildlife collision numbers recorded by the WARS system may only represent 25% to 35% of the actual number of animals killed on roads (Sielecki 2010). The average number of vehicle-moose collisions per year along the 16 km stretch along Highway 52 between Tumbler Ridge and the Murray River FSR can be calculated as 0.64 moose/year using the 0.04 moose/km/year figure. Based on the estimate that the data are under-reported by approximately 70%, the number of vehicle-moose collisions along this stretch of Highway 52 could be as high as 2.1 per year.

Traffic along the access road (approximately 12 km) could result in 0.48 vehicle-moose collisions per year, assuming 0.04 vehicle-moose collisions per kilometre of road, or could be 1.6 vehicle-moose collisions per year if the numbers are inflated to account for error in the WARS data. The rate of vehicle-moose collisions is heavily dependent on traffic speed, with mortality rate dropping abruptly, by approximately 80%, below 70 km/hr (Seiler 2005). Hence, vehicle-related mortality along the access road is expected to be lower per km than on Highway 52 and may well be zero due to the enforcement of speed limits for on-site Project roads.

Residual Effects for Moose due to Direct Mortality

Direct mortality from vehicle-moose collisions is not predicted to result in a residual effect on moose. The highest potential for vehicle-moose interactions will be along Highway 52, with

reduced effects along the access road where speeds will be lower. Moose may use the ploughed access road as a movement corridor during the winter, increasing the chances of a vehicle-moose collision. Low-lying and early seral vegetation on roadsides and the ROW will also attract moose and increase the collision risk during the summer. However, the effect size is expected to be small – approximately 2 moose per year are struck on the road in the RSA. The addition of Project traffic would not significantly change that number and as a consequence, no residual effects of direct mortality are expected.

The potential effects of vehicle-related moose mortality will be mitigated by adherence to a Wildlife Management Plan (Section 24.12). Mitigation along the access road will include adherence to speed limits, yielding to wildlife observed on roadways, creating breaks in snow banks along the ploughed roads (e.g., run outs at corners of the road), and providing signage in high-value wildlife areas or known wildlife travel corridors. In addition, vegetation will be kept low along the on-site access roads to ensure drivers see wildlife along the sides of the roads, if they are present.

13.7.4 Mitigation Measures for Moose

The Wildlife Management Plan (Section 24.12) describes the mitigation and management activities that are designed to reduce or eliminate potential effects to wildlife. Mitigation measures specific to moose are described in the following sections.

13.7.4.1 Mitigation for Habitat Loss and Alteration

Additional mitigation measures for habitat loss and alteration are detailed in Decommissioning and Closure (Section 3.9). The potential effects of subsidence will be monitored as per the Subsidence Management Plan (Section 24.15). Mitigation for direct habitat loss and alteration on moose will include, but is not limited to:

- avoidance of important habitat where practical alternatives are available (e.g. habitat loss and alteration was minimized through Project design);
- maintain known and potential mineral licks in a natural state and ensure ungulates have access to them during the season when they are most used;
- no destruction or disruption of areas that contain known wallows, particularly during the ungulate breeding season during site clearing in the construction phase and during Construction and Operation; and
- re-vegetation of some reclaimed components during Decommissioning and Reclamation.

13.7.4.2 Mitigation for Sensory Disturbance

The effects of sensory disturbance to moose will be minimized by mitigating the effects of noise (Section 24.3, Noise Management Plan). Guidelines will be followed to minimize the effects of noise on moose and other wildlife (Milko 1998a; BC MOE 2006a).

The following noise mitigation measures will be implemented and are not limited to:

- noise specifications will be considered when selecting equipment to purchase;

- vehicles will be maintained regularly;
- speed limits will be imposed for on-site Project roads;
- mufflers will be installed on vehicles and maintained;
- noise dampening measures will be applied where possible; and
- noise will be monitored periodically at various human and wildlife receptor locations, as part of the Noise Management Plan (Section 24.3) and mitigation strategies will be adjusted accordingly, if required. Noise monitoring locations will be at locations to enable confirmation of noise modelling and effects assessment.

13.7.4.3 Mitigation for Disruption of Movement

The effect of disruption of movement will largely be mitigated by the same mitigation measures for habitat loss (Section 13.7.12.1). Additional mitigation measures for the disruption of movements for moose will include but are not limited to:

- wildlife will be given the right-of-way along access roads and the highway; and
- enforcement of speed limits along on-site Project roads.

13.7.4.4 Mitigation for Direct Mortality

The effect of direct mortality will largely be mitigated by the same mitigation measures for habitat loss (Section 13.7.12.1) and disruption of movement (Section 13.7.12.3).

Specifically, the effect of direct mortality to moose will be mitigated through the following measures:

- scheduling vegetation clearing activities outside of sensitive periods (e.g., high-quality moose winter range (January 1 to March 13) and spring calving period (May 15 to July 15)), where feasible;
- refuge areas will be ploughed along Project roads during winter and gaps in snow banks on roads will be created at best spacing to allow an escape for wildlife such as moose;
- when clearing cannot be schedule outside the moose sensitive periods, a qualified on-site monitor will conduct preconstruction surveys followed by intensive monitoring of the construction area if moose are observed. A buffer distance will be maintained when moose are present;
- adherence to speed limits along on-site Project roads and on Highways 52 and 29;
- communicating locations of wildlife observed along roads;
- yielding to wildlife observed along roads; and
- collisions between Project vehicles and wildlife will be documented and will include information on the location of the collision along Project roads and the highways.

13.7.5 Key Effects on Mountain Goat

Mountain goats were assessed for potential Project-related effects. Habitat loss and alteration and sensory disturbance were considered for the effects assessment because those effects have the potential to interact with mountain goat and result in a residual effect on mountain goat populations.

The effect of disruption of movement was scoped out of this assessment because this effect was determined to have no interaction with mountain goats. The Project site and access roads occur at low elevation and do not bisect areas of high-quality mountain goat habitat, which tend to occur at higher elevations. Hence, it is not expected that the Project will impede the movement of mountain goats between areas of high elevation habitat.

The effect of direct mortality (vehicle strikes) was scoped out of this assessment because this effect was determined to have no interaction with mountain goats. The Project site and access roads are at low elevation and do not overlap any areas of high, moderately high or moderate quality habitat; nor does the Project overlap any areas of mountain goat ungulate winter range (UWR). Nor do the Project facilities or access road bisect areas of high-quality mountain goat range. In addition, the Wildlife Accident Reporting System (WARS) data from BC MOTI does not have any record of mountain goats being struck on highways 29 or 52. Hence, it is not expected that mountain goats will be crossing Project roads and will not be susceptible to vehicle strikes due to the Project.

The effect of indirect mortality was scoped out of this assessment because this effect was determined to have no interaction with mountain goats. Indirect mortality can occur if new access roads provide access to new or otherwise inaccessible areas. No new roads are planned for the Project that will provide new access for hunters and therefore no increase in the area available to hunters is expected.

The effect of attractants was scoped out of this assessment because mountain goats are not known to be attracted to industrial sites. Goats can be attracted to high elevation roads to consume road salt, but no Project roads will be located at high elevation and no attraction of goats to roads is expected.

The potential effect of chemical hazards on mountain goat was scoped out of this assessment in Section 13.6.3.6. The major pathway of chemical uptake in ungulates is from the ingestion of vegetation and soil. Predicted concentrations of COPCs in soil had HQs below 1.0 thus COPCs in soil were screened out of the assessment (Section 18.8.3.1). No vegetation specific guidelines for COPCs are available, however, the soil quality guidelines are considered to be protective against effects to vegetation or higher trophic level consumers. Since predicted soil concentrations are anticipated to be below an HQ of 1.0, uptake of COPCs from vegetation were also screened out of the assessment. While M19A Creek and the wetland habitat between the Coal Processing Site and the Murray River are anticipated to exceed water quality guidelines (for the protection of wildlife) for selenium, very little high-quality habitat for mountain goat was located in these areas and ungulates are anticipated to achieve the majority of their water intake needs through vegetation; thus COPC uptake from water was also scoped out for mountain goat.

The potential residual effects considered in the assessment for mountain goats during Construction, Operation, Decommissioning and Reclamation, and Post Closure phases are summarized in Table 13.7-10, and described in Sections 13.7.13.1 to 13.7.13.3.

Table 13.7-10. Ranking Potential Effects on Mountain Goat

Project Components/ Physical Activities	Potential Effects on Mountain Goat					
	Habitat Loss and Alteration	Sensory Disturbance	Disruption of Movement	Direct and Indirect Mortality	Attractants	Chemical Hazards
Construction						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	L	L	O	O	O	O
Shaft Site	O	L	O	O	O	O
Decline Site	O	L	O	O	O	O
Traffic and Transportation	O	L	O	O	O	O
Operation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	L	L	O	O	O	O
Traffic and Transportation	O	L	O	O	O	O
Decommissioning and Reclamation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	L	O	O	O	O
Post-Closure						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	O	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	O	O	O	O	O

(-) *No spatial or temporal overlap*

O *Spatial and temporal overlap, but no interaction anticipated; no further consideration warranted.*

L *Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; no monitoring required, no further consideration warranted.*

M *Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*

H *Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

13.7.5.1 Habitat Loss and Alteration

Mountain Goat Habitat Requirements and Availability

For mountain goats, escape terrain is the most important factor that determines overall habitat suitability, regardless of season (Côté and Festa-Bianchet 2001; Poole, Stuart-Smith, and Teske 2006; Scheck et al. 2006; Hamel and Cote 2007). Factors such as elevation and aspect appear to influence mountain goat habitat suitability by season.

In winter, snow depths influence available forage as well as the ability of mountain goats to escape predators. Winter living habitat requirements for mountain goats are typically associated with the following habitat attributes:

- Proximity to escape terrain (less than 400 to 500 m most suitable);
- Windswept ridges and rocky outcrops;
- Alpine;
- Mature forests below treeline (extend at least 500 m lower than in summer);
- Warm aspects with lower snow depths and higher access to forage; and
- Winter forage consisting primarily of browse species not covered by snow.

Living habitat requirements for mountain goats during the growing season (spring, summer and fall) are typically associated with the following habitat attributes:

- Proximity to escape terrain;
- Primarily alpine habitat;
- Summer forage consisting of grasses, sedges and rushes; and
- Access to mineral licks in spring.

High-quality habitat was identified on the western and southern portions of the RSA by Habitat Suitability Mapping. These high-quality habitat areas correspond well with the provincially designated Ungulate Winter Range (UWR) for mountain goat. Very little high-quality habitat for either winter or living (spring, summer and fall) seasons is located in the LSA (Figures 13.7-12 and 13.7-13).

Two types of habitat suitability mapping were conducted for the baseline program: 1) habitat mapping conducted in the RSA using Predictive Ecosystem Mapping (PEM) and collar data, and 2) habitat mapping conducted in the LSA using Terrestrial Ecosystem Mapping (TEM). Between these two types of mapping, the mapping in the RSA appears to be more accurate – it correctly identifies high elevation areas in both winter and growing seasons and corresponds well with the provincially designated UWRs in the RSA. The habitat mapping in the LSA, by contrast, identifies a series of low-elevation stream valleys as high-quality habitat. For these reasons, the habitat mapping conducted for the RSA appears to be more biologically realistic and consistent with provincial modelling and was used in the analysis of habitat loss and disturbance in the following sections.

Mountain Goat Habitat Loss and Alteration

Habitat Loss and Alteration due to the Mine Site Assessment Footprint

Of the 9,641 ha of the total high-quality mountain goat habitat identified in the RSA, a total of 46 ha will be lost within the Mine Site Assessment Footprints. This is equivalent to 0.2% of the total high-quality mountain goat habitat (all seasons combined) available within the RSA, or 36% of that available in the LSA (Table 13.7-11; Figures 13.7-12 and 13.7-13). The loss of habitat will primarily occur where there are riparian and mature stands of forests adjacent to the Murray River in relatively low elevation areas, which are generally of less habitat value for goats. A small area of high-quality mountain goat habitat is located in the LSA (125 ha), or only 0.65% of the habitat available in the RSA. Project infrastructure will remove and/or alter a fairly large proportion of the habitat available in the LSA (36%). However, this percentage is misleading, since the area of high-quality habitat in the LSA (125 ha) is very small. Overall, the Project will remove 46 ha of high-quality goat habitat, which is 0.2% of the high-quality habitat available in the RSA.

Table 13.7-11. Mountain Goat High-quality Habitat Loss and Alteration due to the Project Mine Site Assessment Footprint

		Regional Study Area		Local Study Area	
Season	High-quality Habitat Lost and Altered (ha)	Total High-quality Habitat (ha)	High-quality Habitat Lost/Altered (%)	Total High-quality Habitat (ha)	High-quality Habitat Lost/Altered (%)
Mountain Goat Winter Living Habitat	24	9,641	0.2	125	19
Mountain Goat Growing Living Habitat	45	9,641	0.4	125	36
Total Mountain Goat Habitat	46	19,157	0.2	125	36

Habitat Loss or Alteration due to Subsidence

After accounting for habitat lost due to the Mine Site Assessment Footprint, a total of an additional 45 ha of high-quality mountain goat habitat (0.2% of total high-quality habitat available in the RSA) may potentially be altered due to subsidence (Table 13.7-12). Figure 13.7-14 illustrates the total high-quality mountain goat habitat that may be altered within 200 m buffer zone of the coal seam panels where the effect of subsidence is anticipated to occur. The relative risk of change to mountain goat high-quality habitat is depicted by the number of overlapping panels to be mined, based on the Project Description (Section 3.6), where high-quality mountain goat habitat occurs (Table 13.7-12; Figure 13.7-14).

It is unclear how habitat quality for mountain goat will change within the zone of subsidence, and additional high-quality habitat for mountain goat may be created during some seasons as a result of the effects of subsidence on the terrain, and not all high-quality mountain goat habitat within this area may be lost or altered. Thus, the assessment assumes a worst-case scenario whereby calculations are based only on high-quality mountain goat habitat that may be lost as a result of subsidence, but this is potentially an overestimate of actual habitat loss or alteration.

Figure 13.7-12

Mountain Goat: Winter Living Habitat Lost due to the Mine Site Assessment Footprint

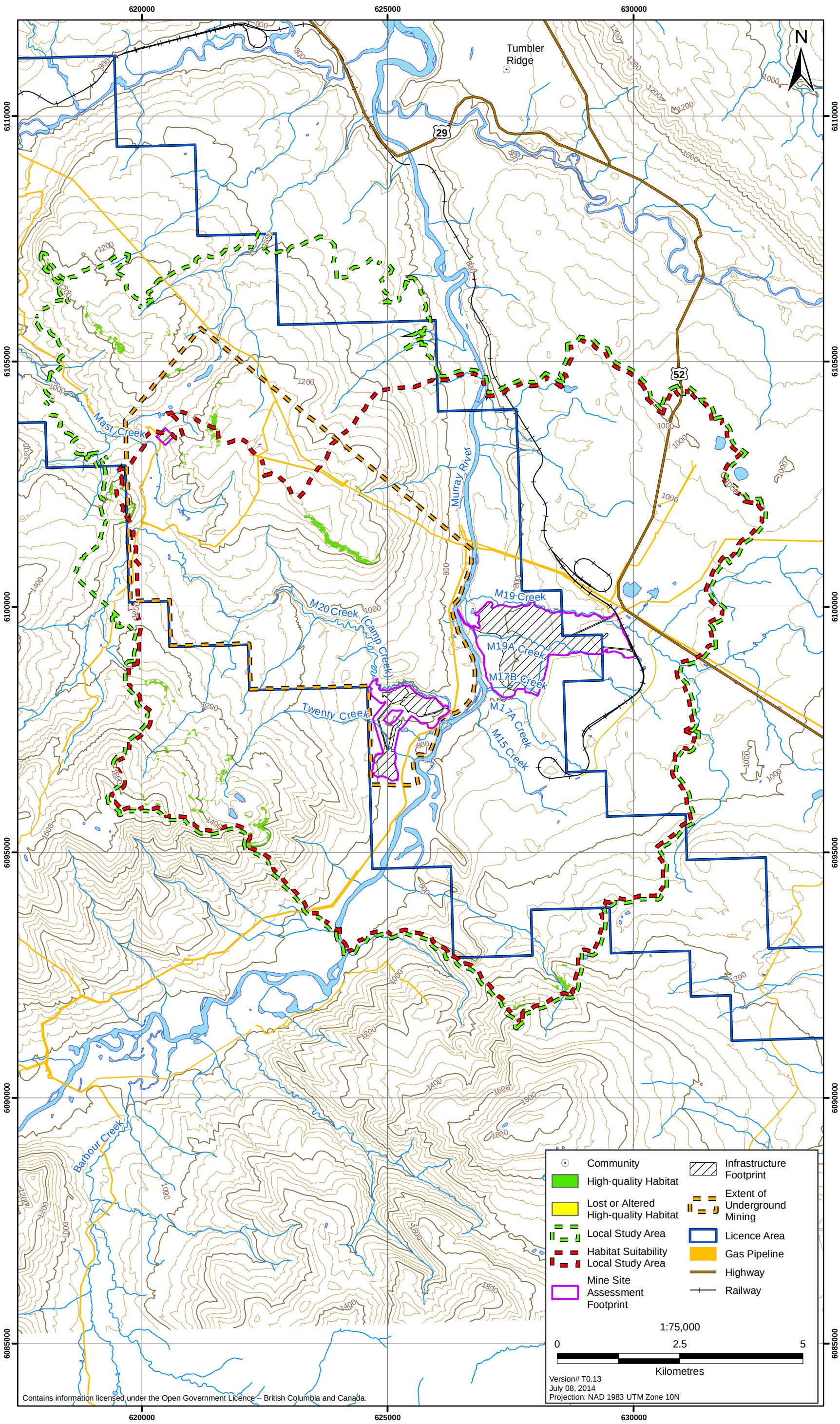


Figure 13.7-13

Mountain Goat: Growing Living Habitat Lost due to the Mine Site Assessment Footprint

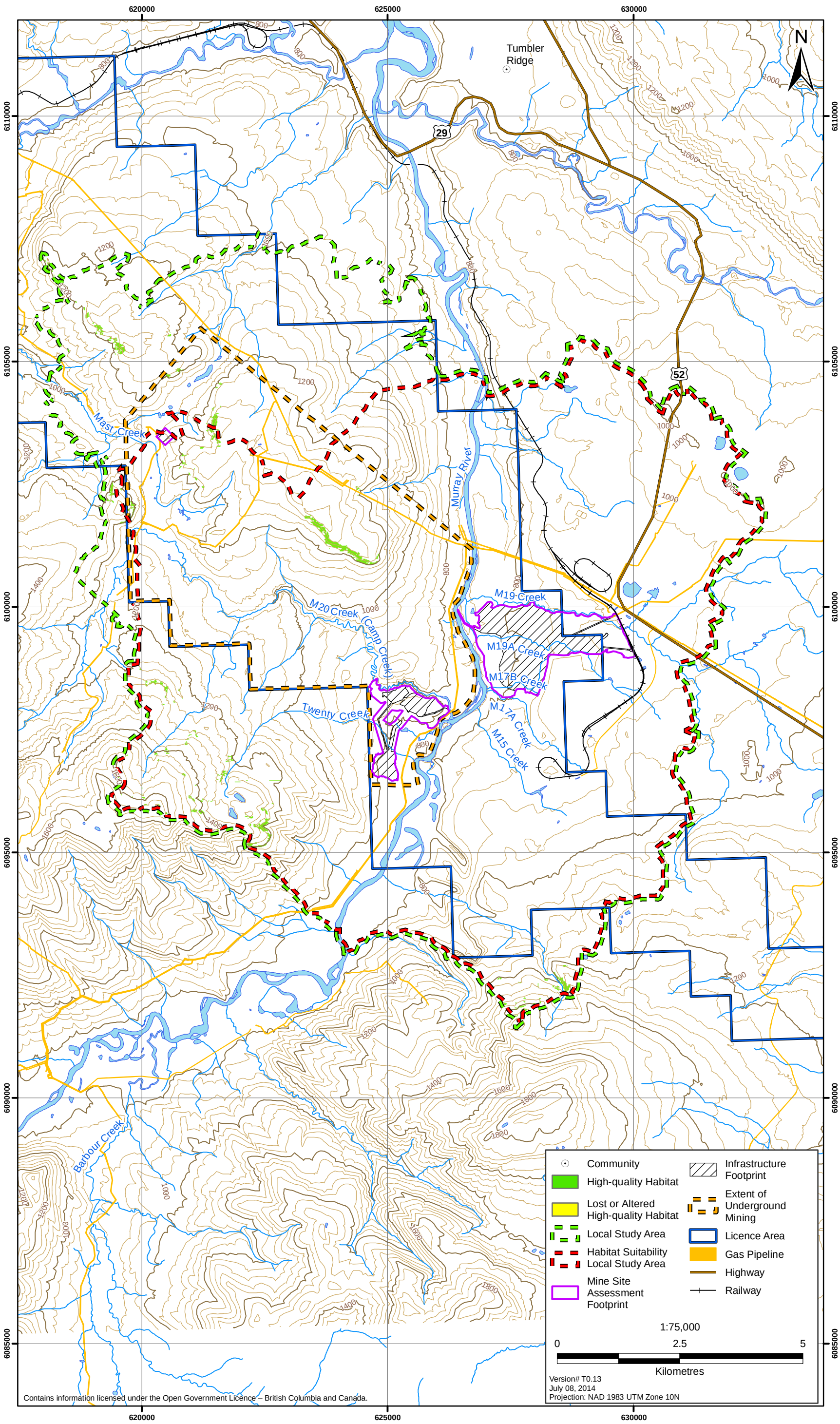


Figure 13.7-14
High-quality Mountain Goat Habitat and Number of Overlapping Coal Seam Panels

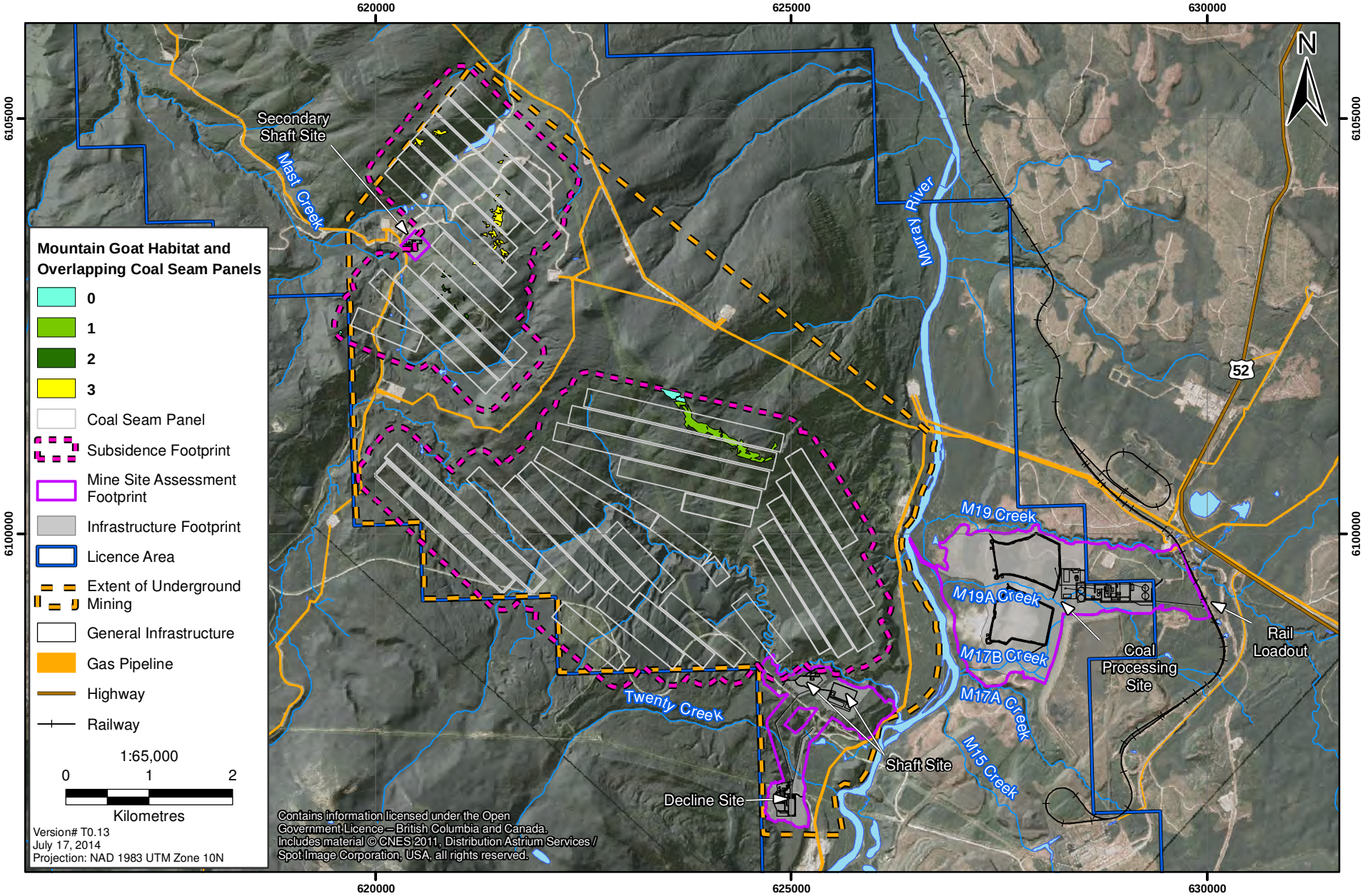


Table 13.7-12. High-quality Mountain Goat Habitat Potentially Altered due to Subsidence

Season	Number of Panels Mined Vertically	Area of High-quality Habitat Potentially Altered (ha)	Regional Study Area		Local Study Area	
			Total High-quality Habitat[1] (ha)	High-quality Habitat Altered (%)	Total High-quality Habitat[1] (ha)	High-quality Habitat Altered (%)
Total Mountain Goat Habitat						
	1	24				
	2	2				
	3	14				
	4	0				
	5	0				
	Total[1]	45	19,157	0.2	125	36

[1]*Total includes area within the 200 m buffer where all subsidence may occur*

Residual Effects of Habitat Loss and Alteration for Mountain Goat

The area of high-quality winter and growing season (spring, summer and fall) habitat directly removed by the project and affected by subsidence is predicted to be small (46 and 45 ha, respectively) or 0.4% of that available in the RSA. Due to the small area of high-quality mountain goat habitat predicted to be affected by the Project, no residual effects are predicted.

13.7.5.2 Sensory Disturbance

Potential sources of sensory disturbance for mountain goats associated with the Project include: 1) continuous Project noise, 2) traffic noise, and 3) train noise. Goats have been observed responding to some disturbances, such as helicopter noise, up to 2 km away (Côté 1996; BC MOE 2010b; Cadsand 2012). In contrast, studies report that mountain goats can habituate to disturbances associated with oil and gas development (Wilson and Shackleton 2001), but sudden and novel events continue to evoke startle reactions.

Mountain goats may be displaced from preferred habitat by noise, or they may return after the disturbance is removed. For example, in northern BC, mountain goats were observed to abandon an area that was within 3 km of mining disturbances (helicopters, drilling, noise), but returned after the disturbance was removed (Foster and Rahs 1983; Gordon and Wilson 2004).

Three types of noise effects were evaluated for potential effects on mountain goat:

1. Project noise at the Mine Site Assessment Footprint = functionally lost
2. Vehicle noise along the access roads = degraded habitat
3. Train noise along the train route = low level disturbance

Noise modelling results were used to determine the area of mountain goat summer and winter habitat that may be functionally lost or disturbed due to sensory disturbance during Construction and Operation and due to instantaneous noise from traffic and trains. The total area of high-quality winter and summer habitat that falls outside of the area of direct habitat lost due to the Project footprint, but within the noise level contours of 45 dBA (Project noise), 75 dBA LAE (traffic and train noise) or greater was calculated.

Mountain Goat Habitat Functionally Lost or Disturbed due to Noise

Continuous Project Noise: Of the 19,157 ha of high-quality mountain goat habitat identified within the RSA, zero ha will be affected by Project noise during Construction after accounting for high-quality mountain goat habitat lost or altered within the Mine Site Assessment Footprints as a result of construction of the mine (Section 13.7.5.1) (Table 13.7-13; Figures 13.7-15 and 13.7-16).

Table 13.7-13. Functional Loss of High-quality Mountain Goat Habitat due to Sensory Disturbance during Construction and Operation

		Regional Study Area			Local Study Area		
Type of Sensory Disturbance	Project Phase	High-quality Habitat Available (ha)	High-quality Habitat Functionally Lost (ha)	% High-quality Habitat Lost in RSA	High-quality Habitat Available (ha)	High-quality Habitat Functionally Lost (ha)	% High-quality Habitat Lost in LSA
		19,157			125		
Continuous Project Noise (45 dBA)							
	Construction		0	0		0	0
	Operation		0	0		0	0
Instantaneous Traffic Noise(75 dBA)							
	Construction		0	0		0	0
	Operation		0	0		0	0
Instantaneous Train Noise (75 dBA)							
	Construction		-	-		-	-
	Operation		1,118	11		0.6	4.8

Instantaneous Vehicle Traffic Noise: The total amount of high-quality mountain goat habitat affected by elevated traffic noise levels (75 dBA Ln or greater), after accounting for habitat lost or altered to clearing activities (Section 13.7.5.1), and that functionally lost to continuous Project noise, is zero ha (Table 13.7-13 Figure 13.7-15) and zero ha during Operation (Table 13.7-13 Figure 13.7-16).

Instantaneous Train Noise: No Project-related trains are anticipated to run during Construction. During Operation, the total amount of high-quality mountain goat habitat affected by elevated train noise levels (75 dBA Ln or greater) after accounting for high-quality habitat lost due to habitat loss and alteration (Section 13.7.5.1), and that functionally lost to continuous Project noise and instantaneous traffic noise is 1,118 ha (11% of the high-quality habitat in the RSA) of which 0.6 ha are disturbed in the LSA accounting for 4.8% of the high-quality mountain goat habitat in the LSA (Table 13.7-13 Figure 13.7-16).

Residual Effects of Sensory Disturbance for Mountain Goat

The area of high-quality winter and growing season (spring, summer and fall) habitat for goats affected by disturbance due to Project facilities and vehicles, and so evaluated as functionally lost or degraded, is predicted to be zero. The areas of high-quality habitat affected by train noise, and evaluated as a low-level disturbance effect, are small in the LSA (0.6 ha), but larger in the RSA (11%). This is anticipated to be a very conservative estimate (overestimate) of the potential effects on mountain goats. Trains will run twice per day in the RSA and there is no evidence that goats avoid areas due to noise from trains. Due to the small area of high-quality mountain goat habitat predicted to be affected by the Project, no residual effects are predicted.

13.7.6 Mitigation Measures for Mountain Goat

The Wildlife Management Plan (Section 24.12) describe the mitigation and management activities that are designed to reduce or eliminate potential effects to wildlife. Mitigation measures specific to mountain goat are described in the following sections.

13.7.6.1 Mitigation for Habitat Loss and Alteration

The effects of habitat loss and alteration on all wildlife, including mountain goat will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). Additional mitigation measures for habitat loss and alteration are detailed in Decommissioning and Reclamation (Section 3.9). The potential effects of subsidence will be monitored as per the Subsidence Management Plan (Section 24.15). Mitigation for direct habitat loss and alteration on mountain goat will include, but is not limited to:

- avoidance of important habitat where practical alternatives are available (e.g. habitat loss and alteration was minimized through Project design);
- Maintain known and potential mineral licks in a natural state and ensure ungulates have access to them during the season when they are most used; and
- re-vegetation of some reclaimed components during Decommissioning and Reclamation.

13.7.6.2 Mitigation for Sensory Disturbance

The effects of sensory disturbance on all wildlife, including mountain goat will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effects of sensory disturbance to mountain goat will be minimized by mitigating the effects noise (Section 24.3, Noise Management Plan). Guidelines will be followed to minimize the effects of noise on mountain goat and other wildlife (Milko 1998a; BC MOE 2006a).

The following noise mitigation measures will be implemented and are not limited to:

- noise specifications will be considered when selecting equipment to purchase;
- vehicles will be maintained regularly;
- speed limits will be imposed for on-site Project roads;

Figure 13.7-15

Mountain Goat: Functional Habitat Loss of High-quality Habitat due to Noise - Construction

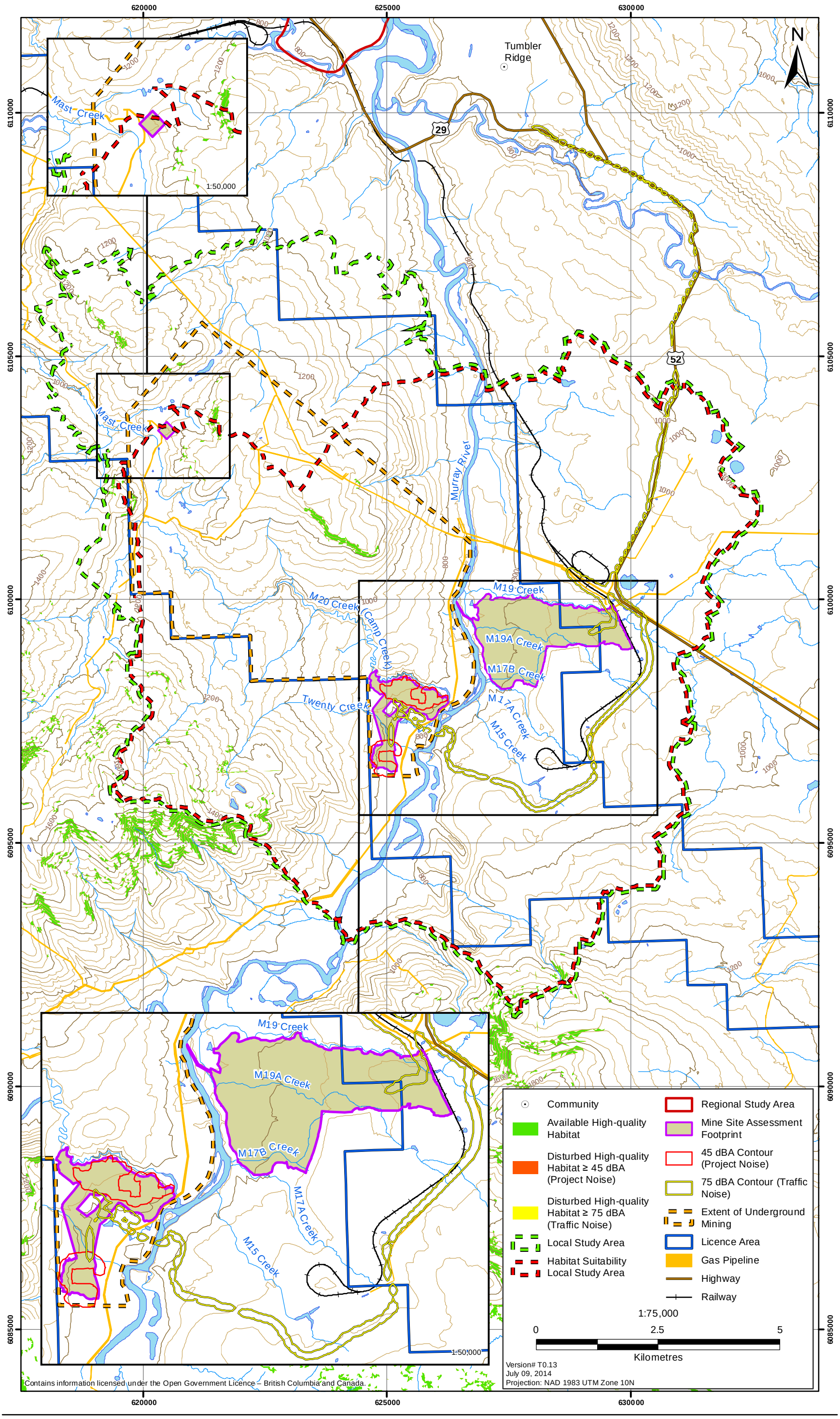
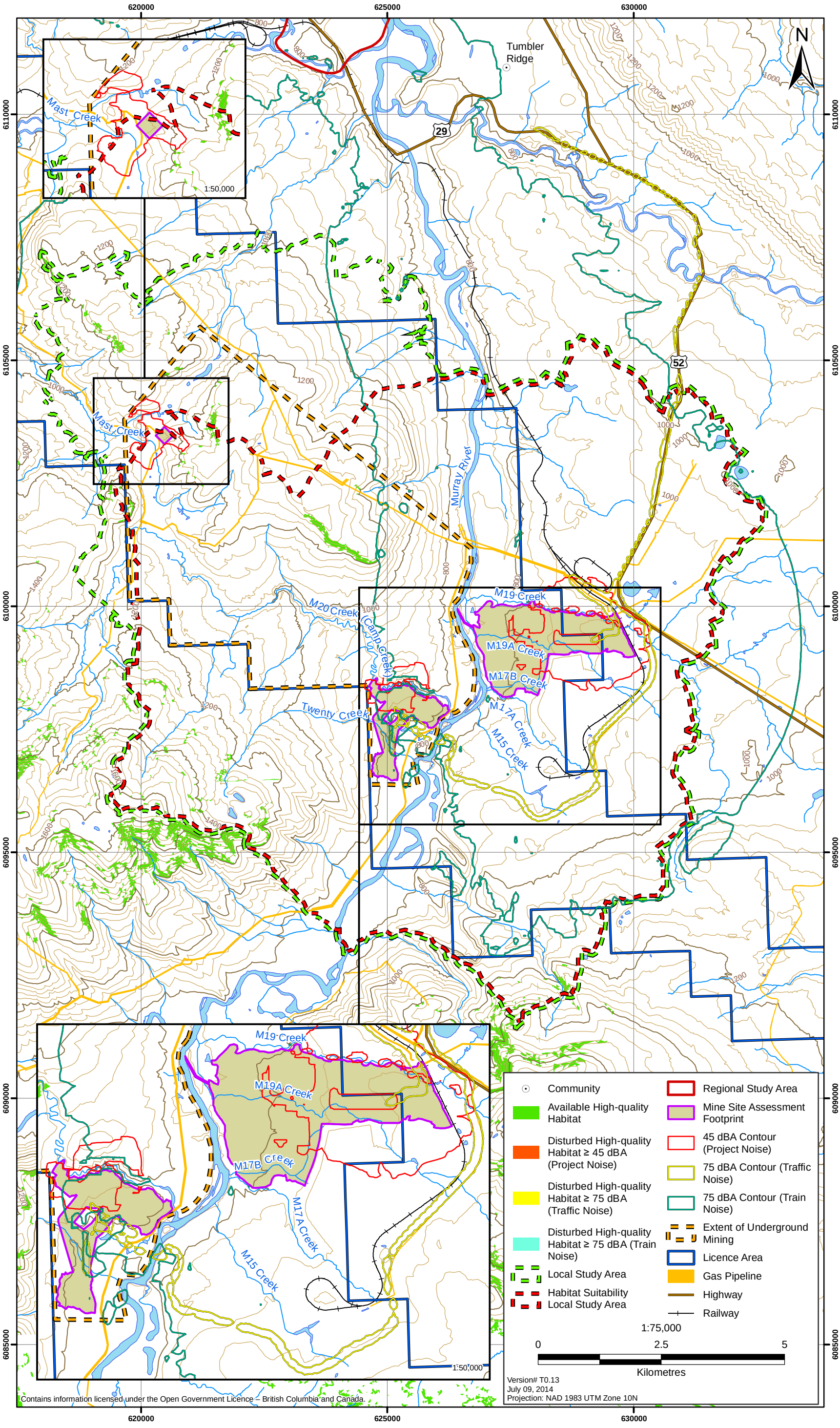


Figure 13.7-16

Mountain Goat: Functional Habitat Loss of High-quality Habitat due to Noise - Operation



- mufflers will be installed on vehicles and maintained;
- noise dampening measures will be applied where possible; and
- noise will be monitored periodically at various human and wildlife receptor locations, as part of the Noise Management Plan (Section 24.3) and mitigation strategies will be adjusted accordingly, if required. Noise monitoring locations will be at locations to enable confirmation of noise modelling and effects assessment.

13.7.7 Key Effects on Elk

Elk were assessed for potential Project-related effects. Habitat loss and alteration, sensory disturbance, disruption of movement, and direct mortality were considered for the effects assessment because these effects have the potential to interact with elk and result in a residual effect on elk populations.

The potential effect of indirect mortality was scoped out of this assessment because this effect is determined to have no interaction with elk. Indirect mortality can occur if new roads are constructed for a project and allow hunters to access a new area. No new roads are planned for the Project that will provide new access for hunters and therefore no increase in the area available to hunters is expected.

The potential effect of attractants was scoped out of this assessment. New project roads can also act as an attractant for elk due to roadside salt, roadside vegetation, and ease of movement. However, new roads are not planned for the Project and therefore no increase in attraction by elk to the Project facilities is expected.

The potential effect of chemical hazards on elk was scoped out of this assessment in Section 13.6.3.6. The major pathway of chemical uptake in ungulates is from the ingestion of vegetation and soil. Predicted concentrations in soil had HQs below 1.0 thus COPCs in soil were screened out of the assessment (Section 18.8.3.1). No vegetation specific guidelines for COPCs are available, however, the soil quality guidelines are considered to be protective against effects to vegetation or higher trophic level consumers. Since predicted soil concentrations are anticipated to be below an HQ of 1.0, uptake of COPCs from ingestion of vegetation were also screened out of the assessment for elk. While M19A Creek and the wetland habitat between the Coal Processing Site and the Murray River are anticipated to exceed water quality guidelines (for the protection of wildlife) for selenium, ungulates are anticipated to achieve the majority of their water intake needs through vegetation; thus COPC uptake from water was scoped out for elk.

The potential residual effects considered in the assessment for elk during Construction, Operation, Decommissioning and Reclamation, and Post Closure phases are summarized in Table 13.7-14, and described in Sections 13.7.7.1 to 13.7.7.4.

13.7.7.1 Habitat Loss and Alteration

Habitat for elk was only mapped within the LSA for Habitat Suitability modelling. The amount of area lost and associated percentages for the LSA and RSA in the following sections have been extrapolated from the available habitat within the Habitat Suitability LSA. It was assumed that the same percentage of high-quality habitat available within the LSA is also available within the RSA.

Table 13.7-14. Ranking Potential Effects on Elk

Project Components/ Physical Activities	Potential Effects on Elk					
	Habitat Loss and Alteration	Sensory Disturbance	Disruption of Movement	Direct and Indirect Mortality	Attractants	Chemical Hazards
Construction						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	L	L	L	L	O	O
Shaft Site	O	L	O	O	O	O
Decline Site	O	L	O	O	O	O
Traffic and Transportation	O	L	L	L	O	O
Operation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	L	L	L	L	O	O
Traffic and Transportation	O	L	L	L	O	O
Decommissioning and Reclamation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	L	L	L	O	O
Post Closure						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	O	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	O	O	L	O	O

(-) *No spatial or temporal overlap*

O *Spatial and temporal overlap, but no interaction anticipated; no further consideration warranted.*

L *Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; no monitoring required, no further consideration warranted.*

M *Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*

H *Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

Elk Habitat Requirements and Availability

Elk usually inhabit mountainous areas, although they do not necessarily require steep landscapes (BC MOE 2000). Winter living habitat requirements for elk are associated with early to mid-seral stage areas as well as mature stands with herbaceous understory, wetlands and riparian areas, south-facing aspects, gentle slopes, areas below 1,000 m in elevation, conifer areas for shelter, and canopy closure of greater than 70%. Habitat requirements during the growing season include low elevation valley bottoms and early to mid-seral stage forests in spring, north-facing slopes and subalpine and alpine areas in summer, areas with herbaceous cover in the understory as well as areas with grasses, sedges and forbs.

Elk are a grazers, who prefer drier areas than moose, including open, grassy areas, disturbed landscapes, cutblocks, agricultural areas and other grass-dominated systems, including reclaimed mine sites. Elk are different from many other wildlife species, in that human-disturbed habitats are a benefit to elk populations. Thus, habitat will be reduced during the operation phase of the project, but the reclaimed areas of the Project footprint at closure and any disturbance to forested habitat in the subsidence area will likely be a benefit to elk.

Elk Habitat Loss and Alteration

Habitat loss and alteration were evaluated for the Project. Habitat loss will occur in the Mine Site Assessment Footprints, where forested and wetland areas are converted for use for Project infrastructure, and alteration of habitat is discussed in the area where subsidence may occur due to underground mining.

Habitat Loss and Alteration due to the Mine Site Assessment Footprint

A total of 69,798 ha of high-quality elk habitat was extrapolated to occur within the RSA (Table 13.7-15). Habitat loss due to development of Project facilities will primarily occur where there are riparian and mature stands of forests adjacent to the Murray River, in relatively low elevation areas. This will result in a total of 182 ha of high-quality habitat lost within the Mine Site Assessment Footprints. This is 4.9% of the total high-quality elk habitat (all seasons combined) available within the LSA, and approximately 0.3% of that estimated to be available in the RSA (Table 13.7-15).

Table 13.7-15. Elk High-quality Habitat Loss and Alteration due to the Project Mine Site Assessment Footprint

		Habitat Suitability Local Study Area (12,092 ha)		Regional Study Area (227,616 ha)	
Season	High-quality Habitat Lost and Altered (ha)	Total High-quality Habitat (ha)	High-quality Habitat Lost/Altered (%)	Potential Total High-quality Habitat[1] (ha)	Potential High-quality Habitat Lost/Altered (%)
Elk Winter Habitat	55	495	11.1	9,318	0.6
Elk Living Habitat	128	3,214	3.9	60,499	0.2
Total Elk Habitat	182	3,708	4.9	69,798	0.3

[1] Elk habitat was not modelled for the RSA. Therefore, relative amount of high-quality habitat within the RSA was assumed to occur in the same proportion as that available within the LSA.

A greater proportion of habitat loss will occur for the winter living season habitat (11.1 % of high-quality habitat in the Habitat Suitability LSA and possibly 0.6% of the high-quality habitat in the RSA) relative to the proportion of growing living habitat lost (3.9% of high-quality living habitat available in the Habitat Suitability LSA, and potentially 0.2% of that available in the RSA) as a result of development of mine infrastructure within the Mine Site Assessment Footprints (Table 13.7-15; Figures 13.7-17 and 13.7-18).

At closure, the footprint area will be reclaimed, likely to a matrix of grasses with some forested areas. This type of habitat will likely be beneficial to elk, resulting in a 0.3% increase in habitat in the RSA and 4.9% increase in elk habitat in the LSA.

Habitat Loss or Alteration due to Subsidence

After accounting for habitat lost due to the Mine Site Assessment Footprint, a total of an additional 581 ha of high-quality elk habitat (35.5% of total high-quality habitat available in the LSA and approximately 1.9% in the RSA) may be altered due to subsidence (Table 13.7-16). A larger amount of growing living habitat will be lost compared to winter living habitat. Approximately 34.9% high-quality growing living habitat may be altered within the LSA and approximately 1.9% in the RSA while 3.7% high-quality winter living habitat may be altered in the LSA and approximately 0.2% in the RSA). Figure 13.7-19 illustrates the total high-quality elk habitat that may be altered within 200 m buffer zone of the coal seam panels where the effect of subsidence is anticipated to occur. The relative risk of change to elk high-quality habitat is depicted by the number of overlapping panels to be mined, based on the Project Description (Section 3.6), where more subsidence is anticipated with more mined panels (Table 13.7-16; Figure 13.7-19).

It is unclear how habitat quality for elk will change within the zone of subsidence, and additional high-quality habitat for elk may be created during some seasons as a result of the effects of subsidence on the terrain, and not all high-quality elk habitat within this area may be lost or altered. Thus, the assessment assumes a worst-case scenario whereby calculations are based only on high-quality elk habitat that may be lost as a result of subsidence, but this is potentially an overestimate of actual habitat loss or alteration.

Residual Effects of Habitat Loss and Alteration for Elk

Direct habitat loss and alteration in the Mine Site Assessment Footprints and alteration in the subsidence area is not predicted to result in a residual effect on elk. The amount of high-quality elk habitat (winter and growing season) that will be affected (182 ha) is 4.9% of the total amount of habitat available in the LSA and potentially 0.3% of the total amount of elk habitat available in the RSA. This will be a conversion of forested areas to footprint during the Operation phase of the Project, and reclamation of the footprint to grassy and forested areas at Closure, resulting in a likely net positive or neutral effect on elk habitat.

13.7.7.2 Sensory Disturbance

Elk Habitat Functionally Lost or Disturbed due to Noise

Sensory disturbance was only calculated for the Habitat Suitability LSA as habitat modelling did not occur for the RSA.

Figure 13.7-17

Elk: Winter Season Living Habitat Lost due to the Mine Site Assessment Footprint

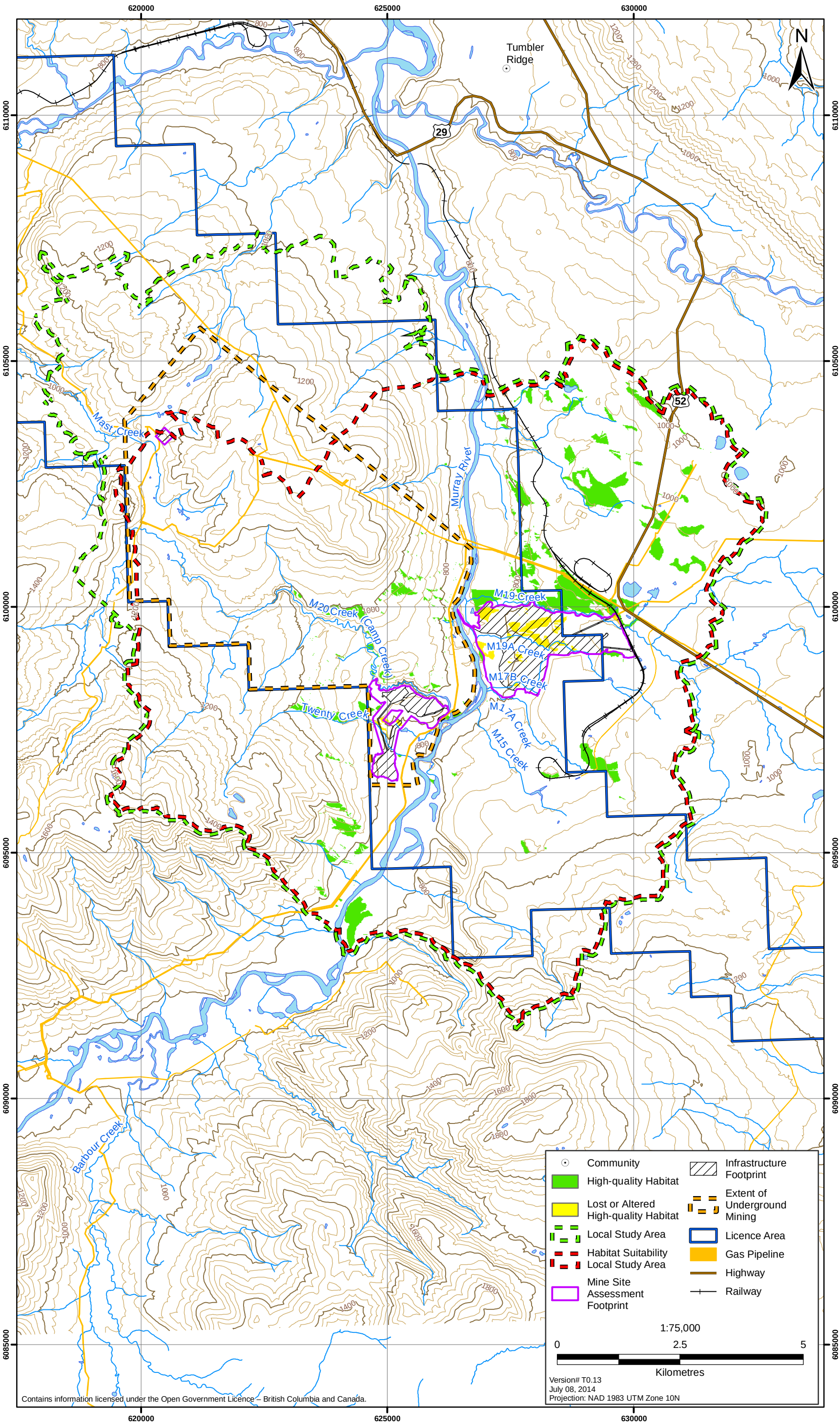


Figure 13.7-18

Elk: Growing Season Living Habitat Lost due to the Mine Site Assessment Footprint

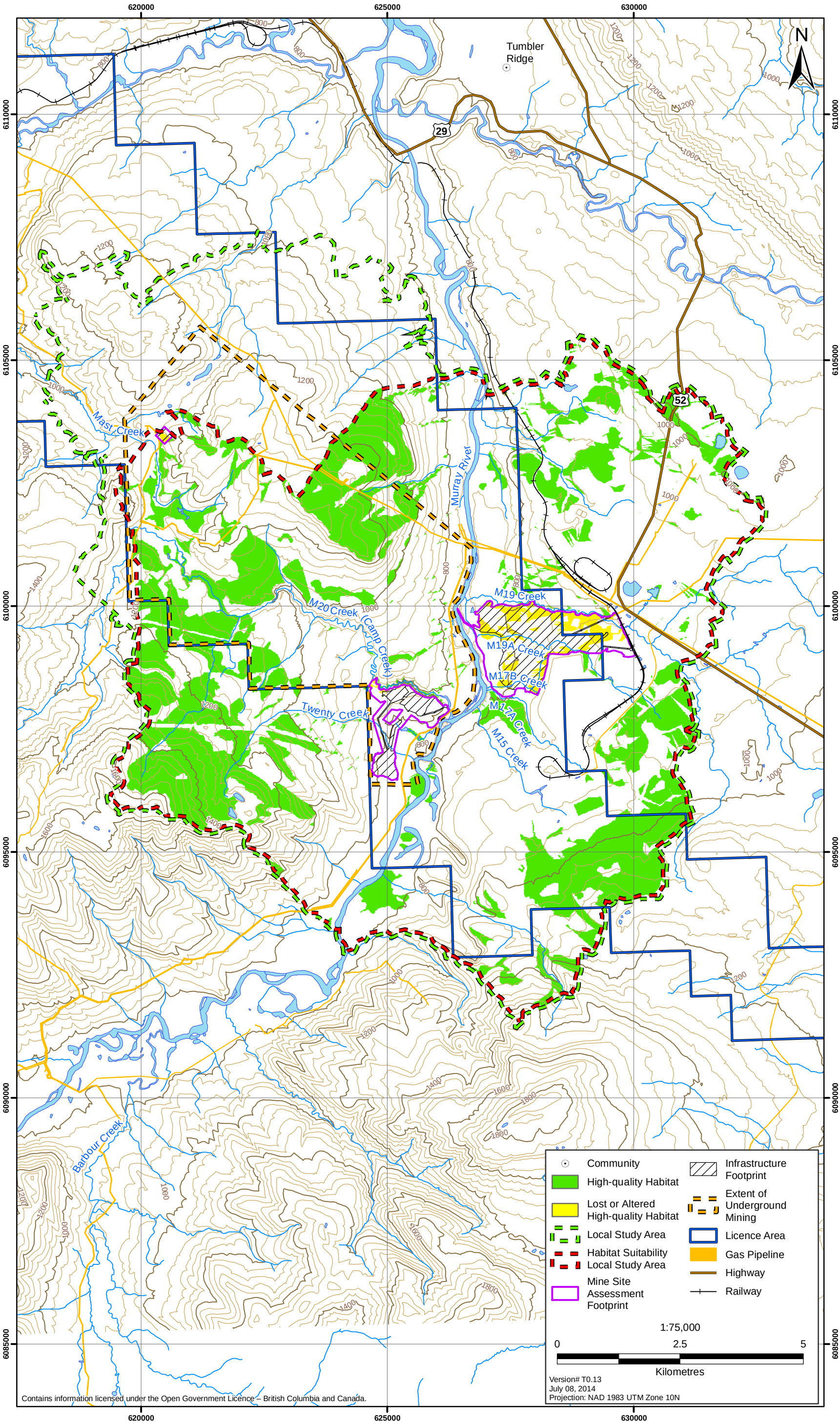
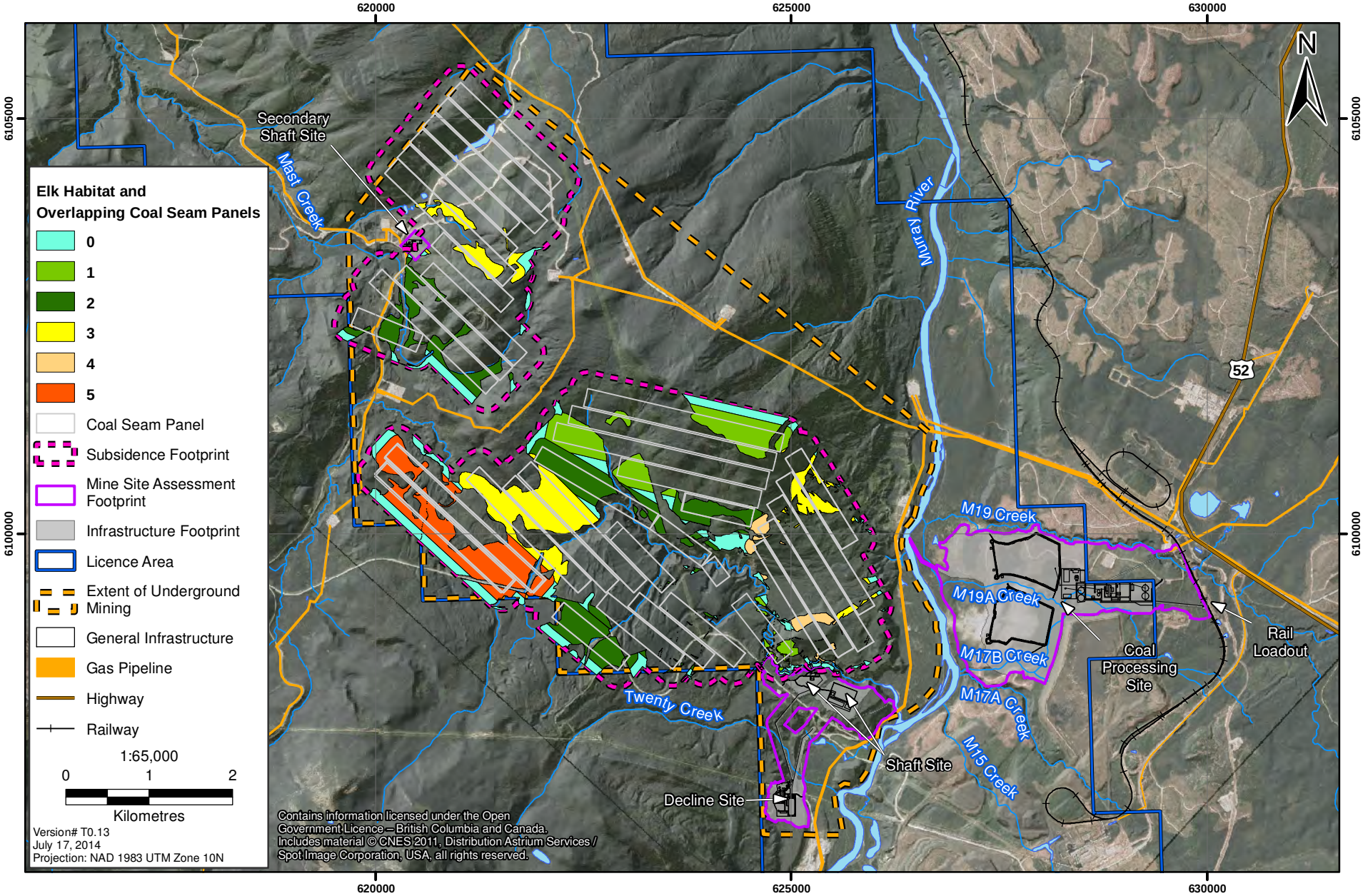


Table 13.7-16. High-quality Elk Habitat Potentially Altered due to Subsidence

Season	Number of Panels Mined Vertically	Area of High-quality Habitat Potentially Altered (ha)	Habitat Suitability Local Study Area (12,092 ha)		Regional Study Area (227,616 ha)	
			Total High-quality Habitat[1] (ha)	High-quality Habitat Altered (%)	Potential Total High-quality Habitat[1] (ha)	Potential High-quality Habitat Altered (%)
Total Elk Habitat						
	1	88				
	2	151				
	3	125				
	4	15				
	5	96				
	Total[1]	581	1,636	35.5	30,796	1.9
Elk Winter Living Habitat	Total[1]	37	1,014	3.7	19,087	0.2
Elk Growing Living Habitat	Total[1]	543	1,555	34.9	29,271	1.9

[1]*Total includes area within the 200 m buffer where all subsidence may occur*

Figure 13.7-19
High-quality Elk Habitat and Number of Overlapping Coal Seam Panels



Three types of noise effects were evaluated for potential effects on elk:

1. Project noise at the Mine Site Assessment Footprint = functionally lost
2. Vehicle noise along the access roads = degraded habitat
3. Train noise along the train route = low level disturbance

Continuous Project Noise: Of the 3,708 ha of high-quality elk habitat identified within the Habitat Suitability LSA, no additional high-quality habitat will be affected by Project noise during Construction after accounting for high-quality elk habitat lost or altered within the Mine Site Assessment Footprints as a result of construction of the mine (Section 13.7.9.1; Table 13.7-17; Figure 13.7-20). During Operation, the total amount of high-quality elk habitat affected by Project noise is 87.6 ha. This is equivalent to 2.4% of the high-quality elk habitat within the LSA (Table 13.7-17; Figure 13.7-21).

Table 13.7-17. Functional Loss of High-quality Elk Habitat due to Sensory Disturbance during Construction and Operation

Type of Sensory Disturbance	Project Phase	Habitat Suitability Local Study Area (12,092 ha)		
		High-quality Habitat (ha)	High-quality Habitat Functionally Lost (ha)	% High-quality Habitat Lost in LSA
		3,708		
Continuous Project Noise (45 dBA)				
	Construction		0.0	0.0
	Operation		87.6	2.4
Instantaneous Traffic Noise(75 dBA)				
	Construction		31.9	0.9
	Operation		12.7	0.3
Instantaneous Train Noise (75 dBA)				
	Construction		-	-
	Operation		1,528	41.2

Instantaneous Vehicle Traffic Noise: The total amount of high-quality elk habitat affected by elevated traffic noise levels (75 dBA Ln or greater), after accounting for habitat lost or altered to clearing activities (Section 13.7.7.1), and functionally lost due to continuous Project noise, is 31.9 ha (0.9% of the high-quality habitat available in the LSA) during Construction (Table 13.7-17; Figure 13.7-20) and 12.7 ha during Operation, accounting for 0.3% of high-quality habitat available in the LSA (Table 13.7-17; Figure 13.7-21).

Instantaneous Train Noise: No Project-related trains are anticipated to run during Construction. During Operation, the total amount of high-quality elk habitat affected by elevated train noise levels (75 dBA Ln or greater) after accounting for high-quality habitat lost due to habitat loss and alteration (Section 13.7.7.1), and that functionally lost to continuous Project noise and instantaneous traffic noise is 1,528 ha accounting for 41.2% of the high-quality habitat in the LSA (Table 13.7-17; Figure 13.7-21).

Residual Effects of Sensory Disturbance for Elk

The area where elk habitat is predicted to be functionally lost due to disturbance at the Mine Site Assessment Area will be approximately 88 ha during Operation, or 2.4% of the high-quality habitat in the LSA. The area where elk habitat was assessed as degraded due to vehicle noise was approximately 13 ha, or 0.3% of the high-quality habitat in the LSA. The area where elk are predicted to have low-level disturbance effects is 1,528 ha, or 41% of the LSA. However, elk and other ungulates are known to have good habituation responses to infrequent, low-level disturbances such as trains. Due to the relatively small area where habitat may be functionally lost and the temporary nature of both rail and vehicle noise, the effect is considered negligible; therefore, no residual effect of sensory disturbance on elk is predicted. Continuous noise (88 ha) may displace 2 elk due to avoidance, and is considered in conjunction with disruption of movement (Section 13.7.7.3).

13.7.7.3 Disruption of Movement

Elk are generally considered robust to human-caused disturbances. Elk use human-disturbed landscapes and are frequently found in agricultural areas, cutblocks and rural landscapes. More than other ungulates, they are also acclimate to human presence well and do not appear to avoid low to moderate disturbance levels by humans.

The Murray River valley functions as a movement corridor for wildlife, and the Murray River Resource Management Zone was delineated in the Dawson Creek LRMP in part to maintain this function. As such disruption of movement was assessed only within this area.

The presence of high-quality elk habitat in the RMZ facilitates movement through the area. A total of 408.7 ha of high-quality elk habitat occurs within the portion of the RMZ that lies within the Habitat Suitability LSA boundary, with a greater amount of high-quality growing season habitat modelled, 269.4 ha, compared to high-quality winter habitat, 139.3 ha (Table 13.7-18). When accounting for all types of disturbance, approximately 31% and 24% of available winter and growing season habitat in the Murray River RMZ portion of the LSA will potentially be affected.

Residual Effects of Disruption to Movement on Elk

Only 14% of the RMZ within the LSA was modelled as high-quality elk habitat, the majority of the habitat was modelled as either low or moderate-quality (Figure 13.7-22). Although 114 ha of high-quality elk habitat will be affected within the RMZ, this represents 4% of the total area of the RMZ within the LSA. Disruption of movement to elk is not predicted to be a residual effect since only a small amount of the habitat modelled within the RMZ was identified as high-quality for elk, only a small percentage of the total area of the RMZ within the LSA is affected and because elk acclimate well to human disturbance.

Figure 13.7-20

Elk: Functional Habitat Loss of High-quality Habitat due to Noise - Construction

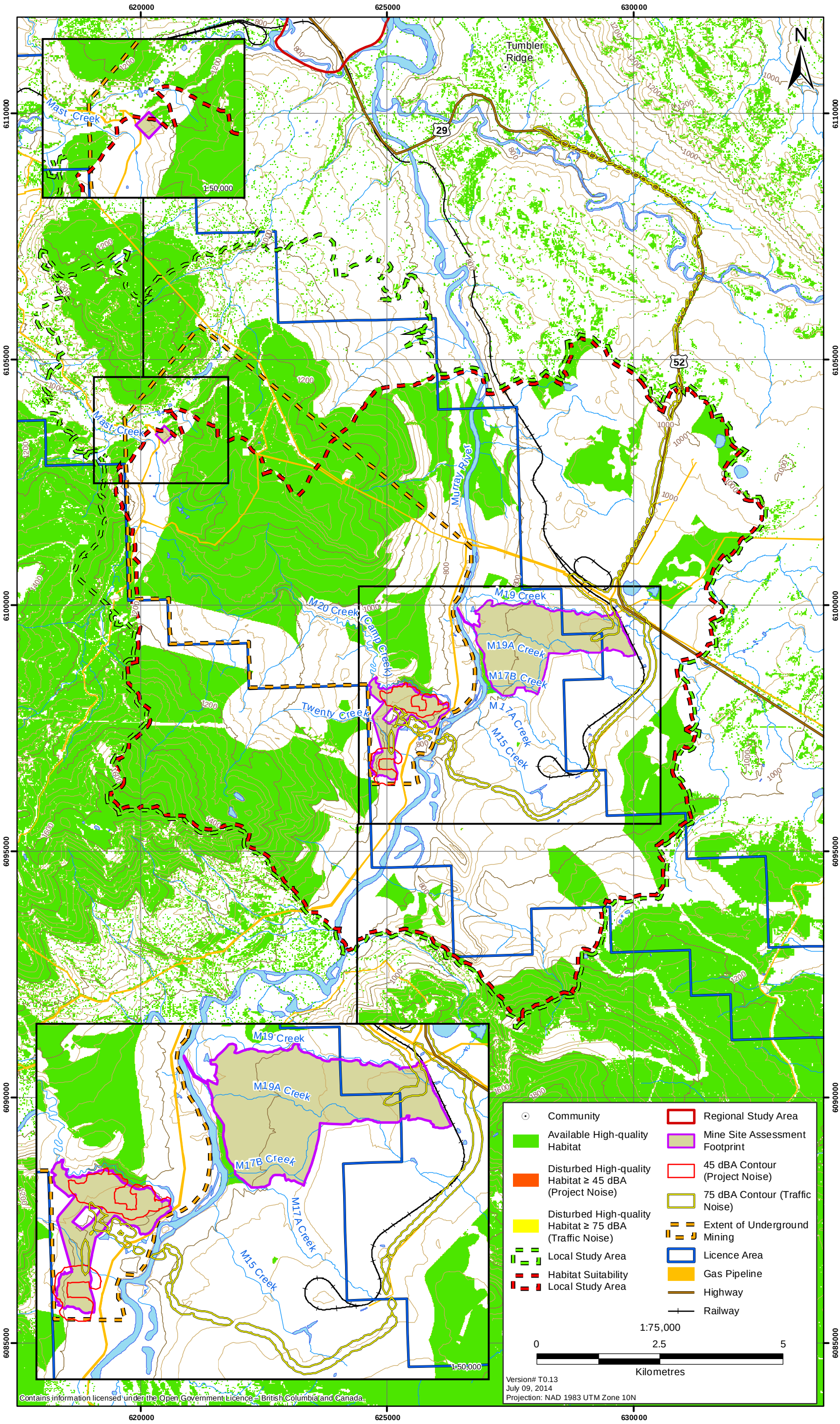


Figure 13.7-21

Elk: Functional Habitat Loss of High-quality Habitat due to Noise - Operation

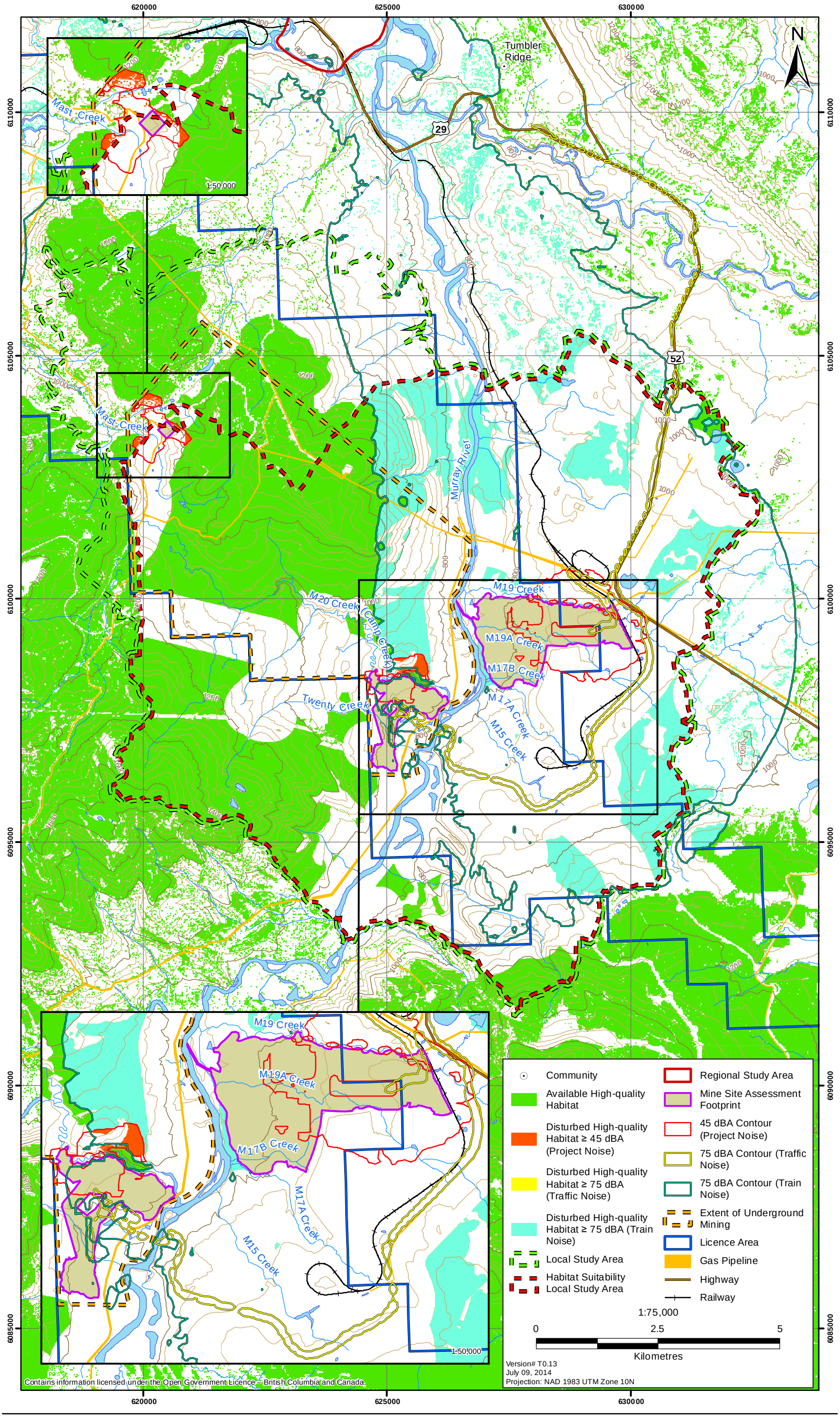


Figure 13.7-22

High-quality Elk Habitat Lost, Altered, or Disturbed within the Murray River Resource Management Zone Corridor

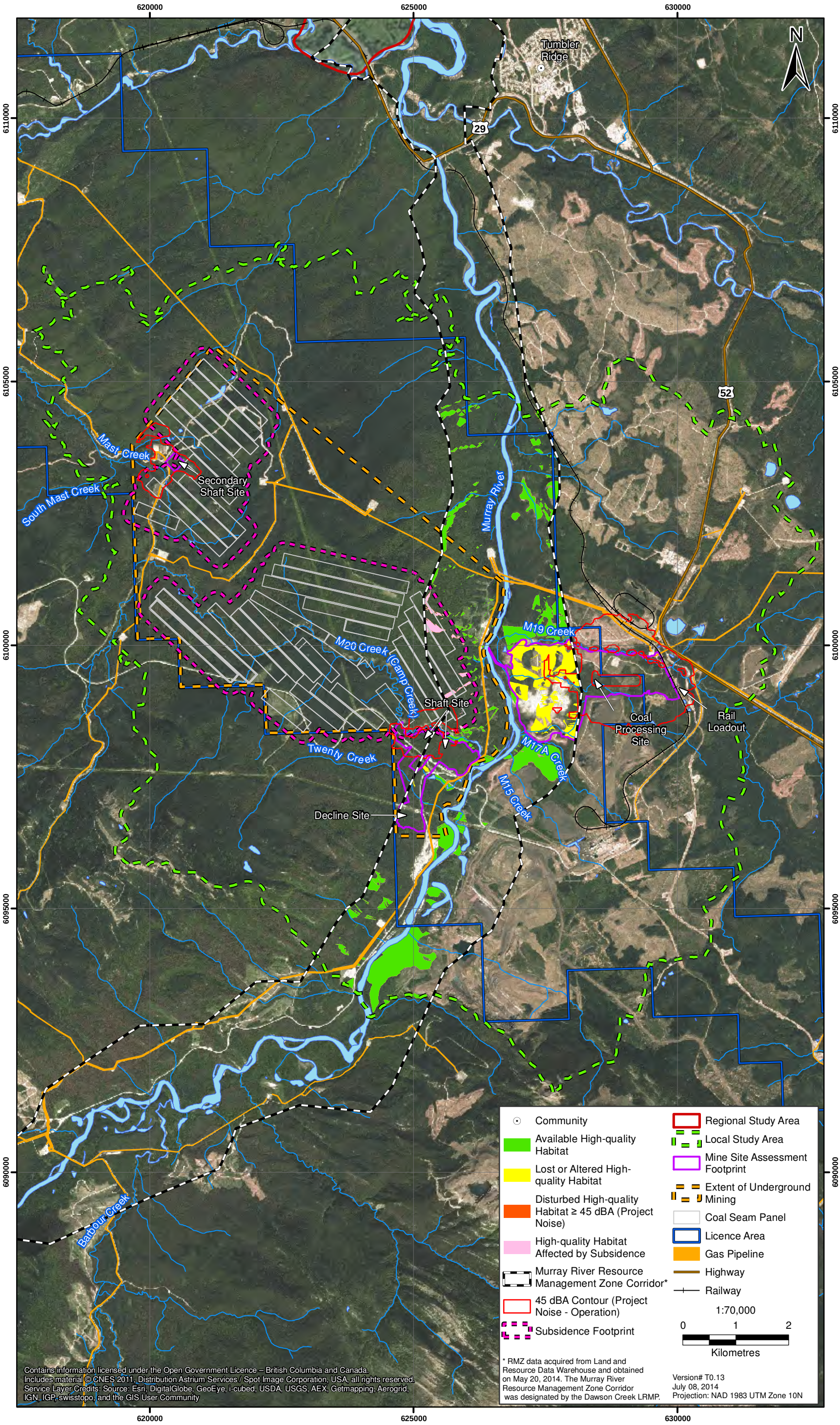


Table 13.7-18. High-quality Elk Habitat Lost, Altered, or Disturbed within the Murray River Resource Management Zone Corridor

Type of Habitat Alteration	Life History Phase	Murray River Corridor within the LSA		
		High-quality Habitat Available (ha)	High-quality Habitat Lost/ Altered (ha)	% High-quality Habitat Lost/ Altered
Total High-quality Habitat within RMZ		408.7		
Winter High-quality Habitat within RMZ		139.3		
Growing High-quality Habitat within RMZ		269.4		
Habitat Loss due to Mine Site Assessment Footprint				
	Winter		34	25
	Growing		65	24
	Total		99	24.2
Habitat Alteration due to Subsidence				
	Winter		9	6
	Growing		6	0.2
	Total		14.5	3.6
Habitat Disturbance due to Continuous Project Noise (45 dBA)				
	Winter		0.17	0.1
	Growing		0.04	0.2
	Total		0.59	0.1

All noise disturbance calculations are during Operation when continuous Project noise will occur for the longest time period.

13.7.7.4 Direct Mortality

Direct mortality of elk was evaluated for the Project because mortality can occur due to vehicle collisions in areas where roads used by the Project overlap high-quality elk habitat. Direct mortality of elk caused by vehicle collisions may occur during the proposed Project Construction, Operation, and Decommissioning and Reclamation phases. Vehicle-moose collisions may occur along Project roads including the access road, Forest Service Roads, as well as along Highway 52.

In general, vehicle-elk collisions, as with vehicle-moose collisions, tend to be aggregated in both time and space. Temporal patterns include changing food availability, seasonal migrations, and snow cover, while spatial factors include location of preferred foraging habitat, landscape topography, and road and traffic characteristics. Increased collision risk with animals is also associated with linear landscape features that funnel animals alongside or across roads, such as riparian corridors, transmission lines, and steep slopes and ridges, and with animal density (Seiler 2005).

During the growing season (spring, summer, and fall), elk may frequent edge habitats, such as road verges, because they contain high-quality forage and provide easy movement. During the winter, access roads will require snow removal. Similar to moose, elk may preferentially use ploughed roads when the winter snowpack is deep. High snow banks of 60 cm or more (Peek et al. 1982) can trap elk on access roads, putting them at greater risk of vehicle strikes.

In BC, information on wildlife collisions are stored in the Wildlife Accident Reporting System. Along Highway 52 within the RSA from km 87 on segment 1171 to km 16 on segment 1198 there have been no elk mortalities reported from the period of 1994 to 2013. Along the 10 km segment of Highway 29 within the RSA from km 84 and higher on segment 1185 there have been 7 elk mortalities reported from 1994 to 2013.

It is estimated that the wildlife collision numbers recorded by the WARS system may only represent 25% to 35% of the actual number of animals killed on roads (Sielecki 2010). The average number of vehicle-elk collisions per year along the 10 km stretch along Highway 29 in the RSA can be calculated as 0.035 elk/km/year. Based on the estimate that the data are under-reported by approximately 70%, the number of vehicle-elk collisions along this stretch of Highway 29 could be as high as 0.06 elk/km/year.

Traffic along the access road (approximately 12 km) could result in 0.4 vehicle-elk collisions per year, assuming 0.035 vehicle-elk collisions per kilometre of road, or could be 0.7 vehicle-elk collisions per year if the numbers are inflated to account for error in the WARS data. The rate of vehicle-elk collisions is heavily dependent on traffic speed, with mortality rates assumed to drop abruptly as for moose, by approximately 80%, below 70 km/hr (Seiler 2005). Hence, vehicle-related mortality along the access road is expected to be lower per km than on Highway 29 and may well be zero with adherence to speed limits.

Residual Effects for Elk due to Direct Mortality

Direct mortality from vehicle-elk collisions is not predicted to result in a residual effect on elk. The highest potential for vehicle-elk interactions will be along Highway 52, with reduced effects along the access road where speeds will be lower. Given that no mortality has been reported along this highway road section in the past 20 years this effect is not considered residual.

Mitigation along the on-site access road will include adherence to speed limits, yielding to wildlife observed on roadways, creating breaks in snow banks along the ploughed roads (e.g., run outs at corners of the road), and providing signage in high-value wildlife areas or known wildlife travel corridors. In addition, vegetation will be kept low along the access roads to ensure drivers see wildlife along the sides of the roads, if they are present. After mitigation, it is anticipated that vehicle-elk collisions will not occur resulting in direct mortality due to increased traffic; therefore, residual effects of direct mortality on elk are not predicted.

13.7.8 Mitigation Measures for Elk

The Wildlife Management Plan (Section 24.12) describe the mitigation and management activities that are designed to reduce or eliminate potential effects to wildlife. Mitigation measures specific to elk are described in the following sections.

13.7.8.1 Mitigation for Habitat Loss and Alteration

The effects of habitat loss and alteration on all wildlife, including elk will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). Additional mitigation measures for habitat loss and alteration are detailed in the Decommissioning and Reclamation (Section 3.9). The potential effects of subsidence will be monitored as per the

Subsidence Management Plan (Section 24.15). Mitigation for direct habitat loss and alteration on elk will include, but is not limited to:

- avoidance of important habitat where practical alternatives are available (e.g. habitat loss and alteration was minimized through Project design);
- Maintain known and potential mineral licks in a natural state and ensure ungulates have access to them during the season when they are most used;
- No destruction or disruption of in areas that contain known wallows, particularly during the ungulate breeding season during site clearing in the construction phase and during Construction and Operation; and
- re-vegetation of some reclaimed components during Decommissioning and Reclamation.

13.7.8.2 Mitigation for Sensory Disturbance

The effects of sensory disturbance on all wildlife, including elk will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effects of sensory disturbance to elk will be minimized by mitigating the effects noise (Section 24.3, Noise Management Plan). Guidelines will be followed to minimize the effects of noise on elk and other wildlife (Milko 1998a; BC MOE 2006a).

The following noise mitigation measures will be implemented and are not limited to:

- noise specifications will be considered when selecting equipment to purchase;
- vehicles will be maintained regularly;
- speed limits will be imposed for on-site Project roads;
- mufflers will be installed on vehicles and maintained;
- noise dampening measures will be applied where possible; and
- noise will be monitored periodically at various human and wildlife receptor locations, as part of the Noise Management Plan (Section 24.3) and mitigation strategies will be adjusted accordingly, if required. Noise monitoring locations will be at locations to enable confirmation of noise modelling and effects assessment.

13.7.8.3 Mitigation for Disruption of Movement

The effects of disruption to movement on all wildlife will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effect of disruption of movement will largely be mitigated by the same mitigation measures for habitat loss (Section 13.7.12.1). Additional mitigation measures for the disruption of movements for elk will include but are not limited to:

- wildlife will be given the right-of-way along access roads and the highway; and
- enforcement of speed limits along on-site Project roads.

13.7.8.4 Mitigation for Direct Mortality

The effects of direct mortality on all wildlife will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effect of direct mortality will largely be mitigated by the same mitigation measures for habitat loss (Section 13.7.12.1) and disruption of movement (Section 13.7.12.3).

Specifically, the effect of direct mortality to elk will be mitigated through the following measures:

- scheduling vegetation clearing activities outside of sensitive periods (e.g., high-quality winter range (January 1 to March 31) and spring calving period (May 15 to July 15)), where feasible;
- when clearing cannot be schedule outside the elk sensitive periods, a qualified on-site monitor will conduct preconstruction surveys followed by intensive monitoring of the construction area if elk are observed. A buffer distance will be maintained when elk are present;
- adhering to speed limits along on-site Project roads and on Highways 52 and 29;
- communicating locations of wildlife observed along roads;
- yielding to wildlife observed along roads; and
- collisions between Project vehicles and wildlife will be documented and will include information on the location of the collision along Project roads and the highways.

13.7.9 Key Effects on Grizzly Bear

Grizzly bear were assessed for potential Project-related effects. Habitat loss and alteration, sensory disturbance, disruption of movement, direct mortality, and attractants were considered for the effects assessment because these effects have the potential to interact with grizzly bear and result in a residual effect on grizzly bear populations.

The effect of indirect mortality was scoped out of this assessment because this effect is determined to have no interaction with grizzly bear. Indirect mortality is primarily associated with the creation of new access into previously undisturbed areas. No new roads are planned for the Project that will provide new access for hunters and therefore no increase in the area available to hunters is expected.

The potential effect of chemical hazards on grizzly bear was scoped out of this assessment in Section 13.6.3.6. The major pathway of chemical uptake in bears is from the ingestion of vegetation. Predicted concentrations of COPCs in soil had HQs below 1.0 thus COPCs in soil were screened out of the assessment (Section 18.8.3.1). No vegetation specific guidelines for COPCs are available, however, the soil quality guidelines are considered to be protective against effects to vegetation or higher trophic level consumers. Since predicted soil concentrations are anticipated to be below an HQ of 1.0, uptake of COPCs from vegetation were also screened out of the assessment. While M19A Creek and the wetland habitat between the Coal Processing Site and the Murray River are anticipated to exceed water quality guidelines (for the protection of wildlife) for selenium, grizzly bear are not susceptible to selenium in the same way that egg-laying animals or ungulates are reported to be. Also, given the very large home range of grizzly bears, the low level of COPCs available at the Project site would be a very small component of the overall diet of grizzly bears and so have no effect on them. Finally, no residual effects are predicted for any prey species which grizzly bears may be consuming. As a consequence, COPCs were screened out of the assessment for grizzly bears.

The potential residual effects considered in the assessment for grizzly bear during Construction, Operation, Decommissioning and Reclamation, and Post Closure phases are summarized in Table 13.7-19, and described in Sections 13.7.9.1 to 13.7.9.5.

Table 13.7-19. Ranking Potential Effects on Grizzly Bear

Project Components/ Physical Activities	Potential Effects on Grizzly Bear					
	Habitat Loss and Alteration	Sensory Disturbance	Disruption of Movement	Direct and Indirect Mortality	Attractants	Chemical Hazards
Construction						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	L	L	M	L	L	O
Shaft Site	O	L	O	O	O	O
Decline Site	O	L	O	O	O	O
Traffic and Transportation	O	L	L	L	O	O
Operation						O
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	L	O
Shaft Site	O	O	O	O	L	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	L	L	O	L	L	O
Traffic and Transportation	O	L	L	L	O	O
Decommissioning and Reclamation						O
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	L	L	L	O	O
Post Closure						O
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	O	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	O	O	L	O	O

(-) *No spatial or temporal overlap.*

O *Spatial and temporal overlap, but no interaction anticipated; no further consideration warranted.*

L *Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; no monitoring required, no further consideration warranted.*

M *Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*

H *Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

13.7.9.1 Habitat Loss and Alteration

Grizzly Bear Habitat Requirements and Availability

Optimal habitat for grizzly bear generally is considered to be road-less areas with a mosaic of early-seral staged forests and natural openings in proximity to forest stands that provide day beds and hiding cover (Herrero 1972, Blanchard 1983, Hamer and Herrero 1987). Habitat selection by grizzly bears varies seasonally (e.g., McLellan and Hovey 1995, 2001, Ciarniello et al. 2003, Milakovic et al. 2011). In mountainous landscapes, the importance of avalanche chutes and unforested alpine areas has been documented (Waller and Mace 1997, McLellan and Hovey 2001, Milakovic et al. 2011). Grizzly bears in landscapes of higher forest productivity with mature-to-old stands of mixed-species composition also use a relatively high proportion of open land-cover classes (Apps et al. 2004). Forested cover may provide opportunities for thermal regulation and security (Blanchard 1983, McLellan 1990). At finer scales, a positive association with higher open cover classes has been related to the potential influence of herbaceous forage value on daily movements (Apps et al. 2004). Areas burned by fire often are highly preferred because of high berry production (Hamer and Herrero 1987, McLellan and Hovey 2001, Milakovic et al. 2011).

Based on the distribution and observed use of habitats from other interior grizzly bear studies (McLellan and Hovey 2001), and more specifically, studies conducted in the adjacent Parsnip River (Ciarniello *et al.* 2003), seasonal habitat use for mountain grizzly bears are expected to show the following general trends:

Denning – Dens in alpine and subalpine areas;

Spring – Snow-free areas found in lower elevation valleys, south facing aspects and avalanche chutes to feed on emergent vegetation;

Summer – Later-melting slopes (mid-elevation herbaceous habitats and north slopes) to take advantage of newly emerging more succulent vegetation, young seral-stage openings (e.g. burns) for berries and subalpine and alpine meadows with Sitka valerian and rodents; and

Fall – Young seral-stage openings (e.g. burns) for late berries and ants in burned stumps, open alpine herbaceous slopes for roots and rodents and carrion when available.

Habitat Loss and Alteration due to the Mine Site Assessment Footprint

Of the 116,504 ha high-quality grizzly bear habitat identified in the RSA, a total of 112 ha will be lost within the Mine Site Assessment Footprints. This is equivalent to 0.1% of the total high-quality grizzly bear habitat (all seasons combined) available within the RSA, or 1.9% of that available in the LSA (Table 13.7-20). The highest proportion of habitat loss will occur from grizzly bear spring living habitat (1.5% of available high-quality spring living habitat in the RSA and 6.7% of the available high-quality spring living habitat in the LSA) relative to the other seasons. (Table 13.7-20; Figures 13.7-23, 13.7-24 and 13.7-25). The loss of habitat will primarily occur where there are riparian and mature stands of forests adjacent to the Murray River in relatively low elevation areas.

Figure 13.7-23

Grizzly Bear: Spring Living Habitat Lost due to the Mine Site Assessment Footprint

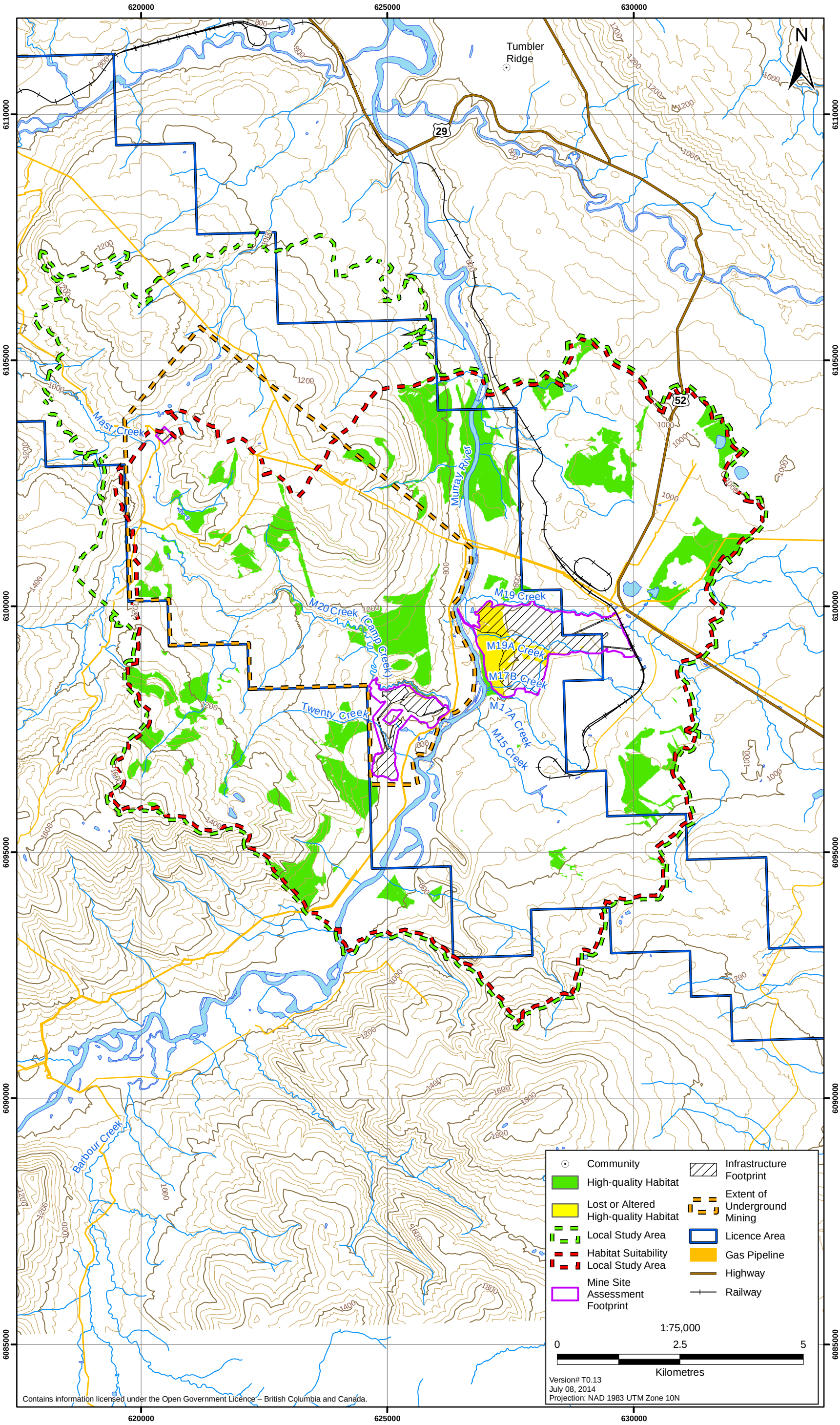


Figure 13.7-24

Grizzly Bear: Summer Living Habitat Lost due to the Mine Site Assessment Footprint

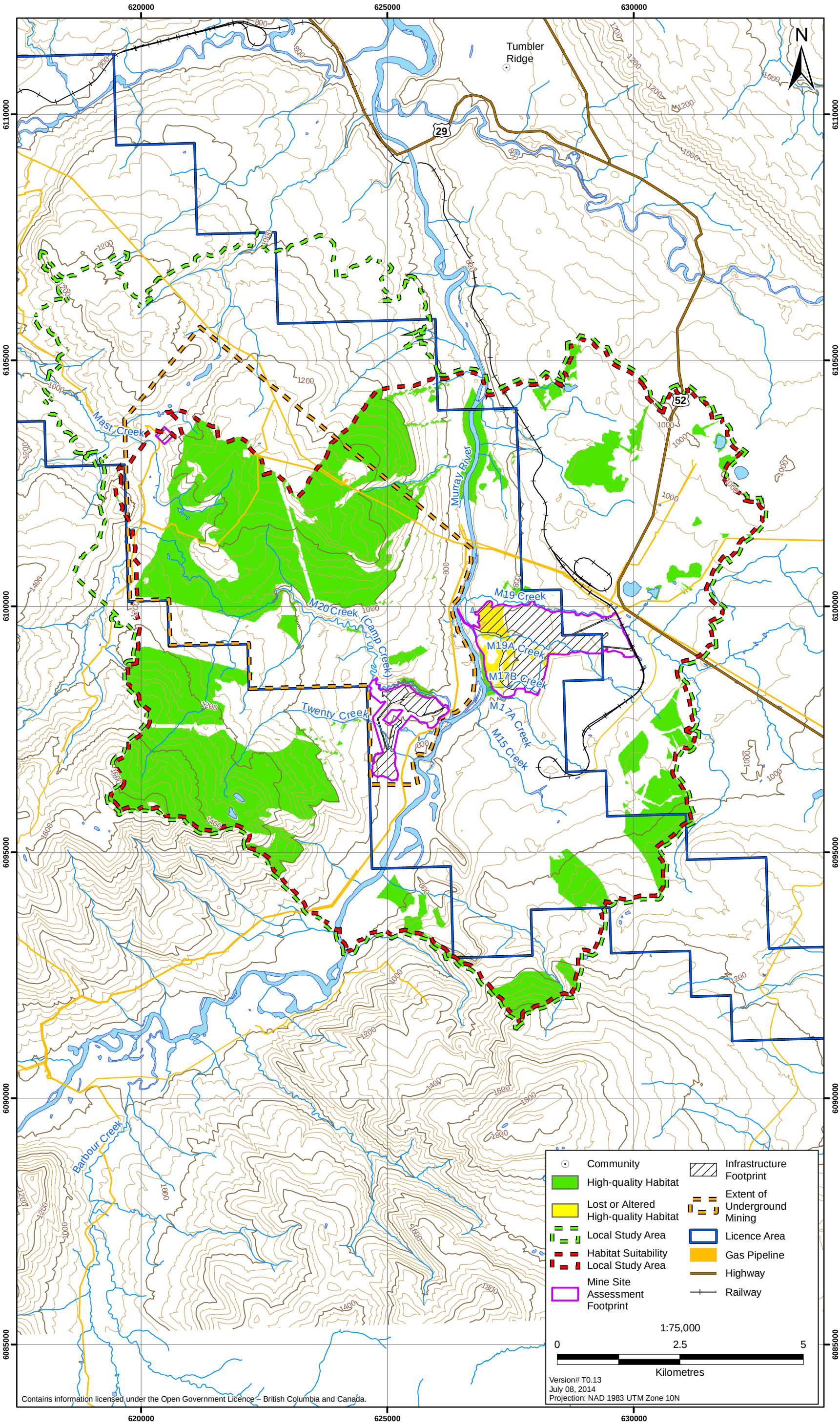


Figure 13.7-25

Grizzly Bear: Fall Living Habitat Lost due to the Mine Site Assessment Footprint

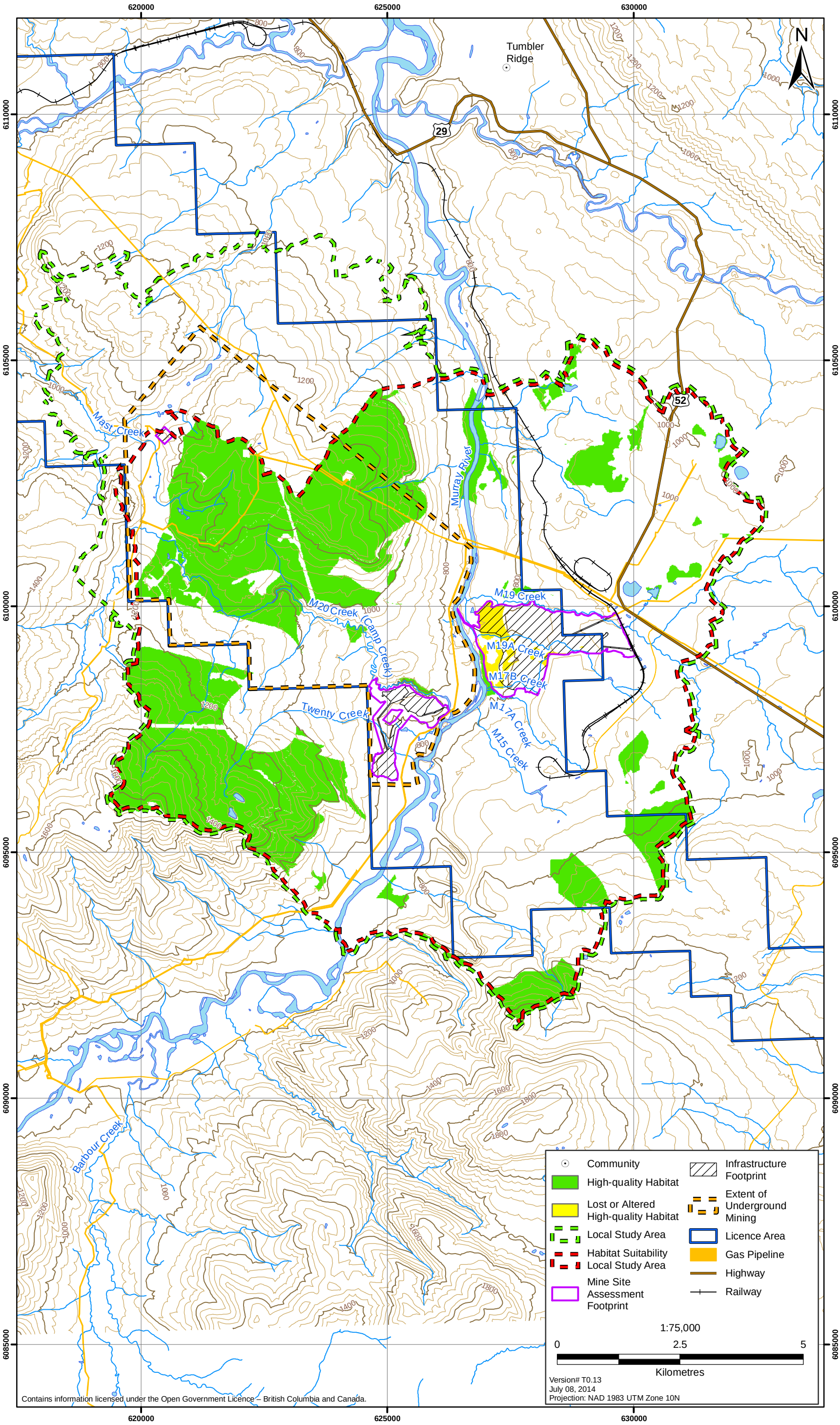


Table 13.7-20. Grizzly Bear High-quality Habitat Loss and Alteration due to the Project Mine Site Assessment Footprint

Season	High-quality Habitat Lost and Altered (ha)	Regional Study Area		Local Study Area	
		Total High-quality Habitat (ha)	High-quality Habitat Lost/Altered (%)	Total High-quality Habitat (ha)	High-quality Habitat Lost/Altered (%)
Grizzly Bear Spring Living Habitat	107	7,143	1.5	1,607	6.7
Grizzly Bear Summer Living Habitat	74.2	42,995	0.2	3,414	2.2
Grizzly Bear Fall Living Habitat	73.2	90,453	0.1	3,458	2.1
Grizzly Bear Hibernating Habitat	0.0	18,015	0.0	NA	NA
Total Bear Habitat	112	116,504	0.1	5,987	1.9

Habitat Loss or Alteration due to Subsidence

After accounting for habitat lost to development in the Mine Site Assessment Footprint, an additional 1,396 ha of high-quality grizzly bear habitat (1.2% of total high-quality habitat available in the RSA, and 23.3% of that available in the LSA) may be altered due to subsidence (Table 13.7-21). The area of available high-quality habitat in the subsidence zone is over three times greater for summer (953 ha) and fall (1,114 ha) than spring (293 ha), but the proportion altered is highest for spring habitat (4.1%) relative to the RSA. In the LSA, a higher proportion of high-quality summer (28%) and fall habitat (32%) is potentially altered relative to spring living habitat (18%).

Table 13.7-21. High-quality Grizzly Bear Habitat Potentially Altered due to Subsidence

Season	Number of Panels Mined Vertically	Area of High-quality Habitat Potentially Altered (ha)	Regional Study Area		Local Study Area	
			Total High-quality Habitat[1] (ha)	High-quality Habitat Altered (%)	Total High-quality Habitat[1] (ha)	High-quality Habitat Altered (%)
Total Grizzly Bear Habitat						
	1	277				
	2	231				
	3	527				
	4	80				
	5	89				
	Total[1]	1,396	116,504	1.2	5,987	23.3
Grizzly Bear Spring Living Habitat	Total[1]	293	7,143	4.1	1,607	18.2
Grizzly Bear Summer Living Habitat	Total[1]	955	42,995	2.2	3,414	28.0
Grizzly Bear Fall Living Habitat	Total[1]	1,114	90,453	1.2	3,458	32.2

[1]*Total includes area within the 200 m buffer where all subsidence may occur*

Figure 13.7-26 illustrates the total high-quality grizzly bear habitat that may be altered, including a 200 m buffer around the area where the effect of subsidence is anticipated to occur. The potential for habitat alteration is represented by the number of underground mine panels where high-quality grizzly bear habitat occurs (Table 13.7-21; Figure 13.7-26). The potential for subsidence is highest in the areas with more vertical panels.

It is unclear how habitat quality for grizzly bears will change within the zone of subsidence, as not all high-quality grizzly bear habitat may be lost or altered and some high-quality habitat for grizzly bears may be created as a result of shifting terrain. The assessment assumes a worst-case scenario whereby high-quality grizzly bear habitat is lost as a result of subsidence.

Residual Effects of Habitat Loss and Alteration for Grizzly Bear

Field data on movements and habitat use by grizzly bears in the area are not available. In a regional comparison, the loss of 112 ha in the Mine Site Assessment Area is equivalent to 1% of a female interior grizzly bear home range and less than 1% of a male interior grizzly bear home range (MacHutchon, Himmer, and Bryden 1993; L. M. Ciarniello 2006). Grizzly bear home range sizes have been estimated to range from 5,200 ha for a female coastal grizzly bear to 18,700 ha for a male interior grizzly bear (MacHutchon, Himmer, and Bryden 1993; L. M. Ciarniello 2006). The amount of high-quality habitat in the area of subsidence that will potentially be altered represents approximately 10% of a female interior grizzly bear home range. In a worst case scenario, this habitat will be unavailable, but the likely case is that the new terrain features may retain some value for grizzly bears, provided they can still access the area.

Habitat loss and alteration is not predicted to result in a residual effect on grizzly bear populations. A minimal amount of habitat will be lost, the majority of which is on the east side of Murray River adjacent to an extensive area of existing disturbance that is likely already avoided by grizzly bears. Over time, reclamation activities will return some habitat value for grizzly bears.

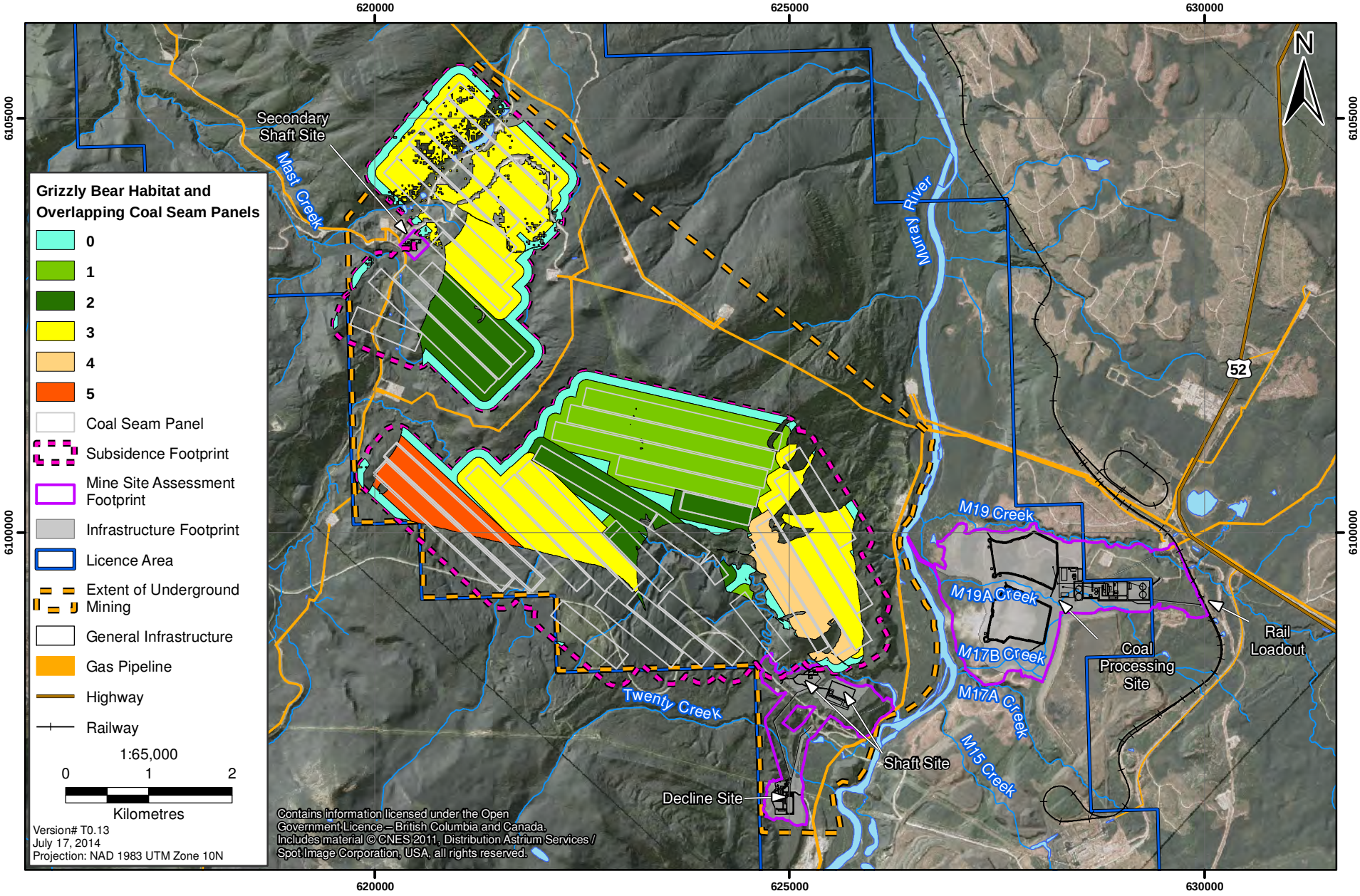
13.7.9.2 Sensory Disturbance

Three types of noise effects were evaluated for potential effects on grizzly bears:

1. Project noise at the Mine Site Assessment Footprint = functionally lost
2. Vehicle noise along the access roads = degraded habitat
3. Train noise along the train route = low level disturbance

Grizzly bears are reported to avoid areas (78 to 80% of the time) with continuous noise levels greater than 60 dBC (Archibald, Ellis, and Hamilton 1987). Grizzly bears frequently alter their behaviour and avoid areas with human activity (such as high-use roads) and periods when humans are most active (Mueller 2001), and generally avoid habitats within 100 to 900 m of roads (Mattson, Knight, and Blanchard 1987; McLellan and Shackleton 1988; Kasworm and Manley 1990). For this assessment, a threshold of 45 dBA was used for Project noise as a conservative estimate.

Figure 13.7-26
High-quality Grizzly Bear Habitat and Number of Overlapping Coal Seam Panels



Noise modelling results were used to determine the area of grizzly bear habitat that may be functionally lost or degraded due to sensory disturbance during construction and operation. For grizzly bears, the total area of high-quality spring, summer, fall, and denning habitat that falls outside of the area of habitat lost or altered due to the Project footprint (Section 18.7.1.4), but within the continuous noise level contours of 45 dBA, and instantaneous noise levels of 75 dBA or greater was calculated.

Grizzly Bear Habitat Functionally Lost or Disturbed due to Noise

Continuous Project Noise: Of the 116,504 ha of high-quality grizzly bear habitat identified within the RSA, a total of 1.5 ha will be affected by Project noise during Construction after accounting for direct habitat loss or alteration of high-quality grizzly bear habitat in the Mine Site Assessment Footprint (Section 13.7.9.1). This is equivalent to < 0.01% of the total high-quality grizzly bear habitat within the RSA or 0.03% of the high-quality grizzly bear habitat available within the LSA (Table 13.7-22; Figure 13.7-27). During Operation, the total amount of high-quality grizzly bear habitat affected by Project noise is 27.2 ha. This is equivalent to 0.02% of the high-quality grizzly bear habitat within the RSA and 0.5% of that within the LSA.

Table 13.7-22. Functional Loss of High-quality Grizzly Bear Habitat due to Sensory Disturbance during Construction and Operation

		Regional Study Area			Local Study Area		
Type of Sensory Disturbance	Project Phase	High-quality Habitat Available (ha)	High-quality Habitat Functionally Lost (ha)	% High-quality Habitat Lost in RSA	High-quality Habitat Available	High-quality Habitat Functionally Lost (ha)	% High-quality Habitat Lost in LSA
		116,504			5,987		
Continuous Project Noise (45 dBA)							
	Construction		1	<0.01		1	0.03
	Operation		27	0.02		27	0.5
Instantaneous Traffic Noise (75 dBA)							
	Construction		2	<0.01		0.0	0.0
	Operation		2	<0.01		0.0	0.0
Instantaneous Train Noise (75 dBA)							
	Construction		-	-		-	-
	Operation		6,975	6.0		1,456	24.3

Instantaneous Vehicle Traffic Noise: The total amount of high-quality grizzly bear habitat affected by elevated traffic noise levels (75 dBA Ln or greater), after accounting for habitat lost or altered to clearing activities (Section 13.7.9.1), and that is functionally lost to continuous Project noise, is 1.9 ha (< 0.01% of the high-quality habitat available in the RSA) during Construction and Operation (Table 13.7-22; Figures 13.7-27 and 13.7-28). No additional habitat will be lost in the LSA associated with instantaneous traffic noise.

Figure 13.7-27

Grizzly Bear: Functional Habitat Loss of High-quality Habitat due to Noise - Construction

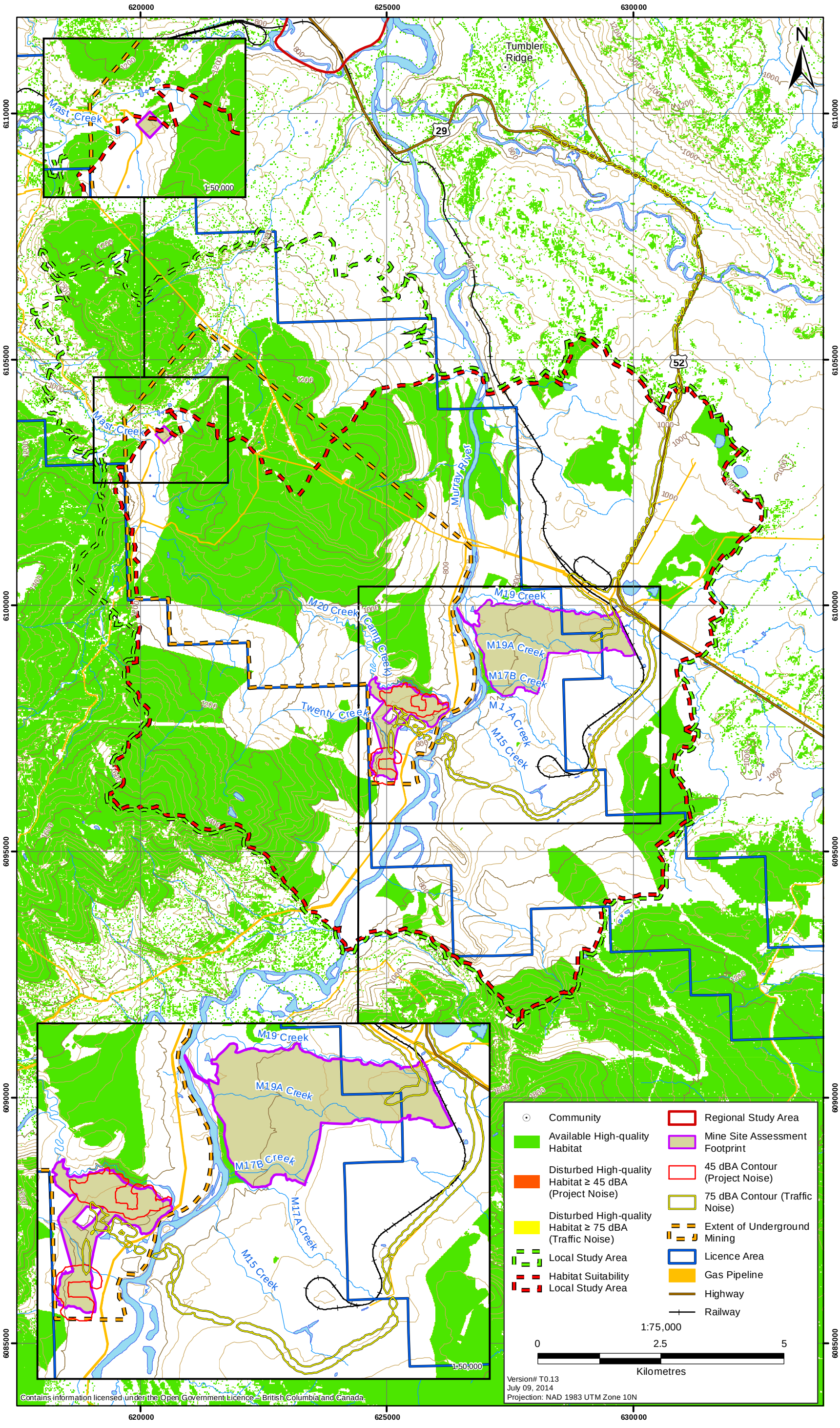
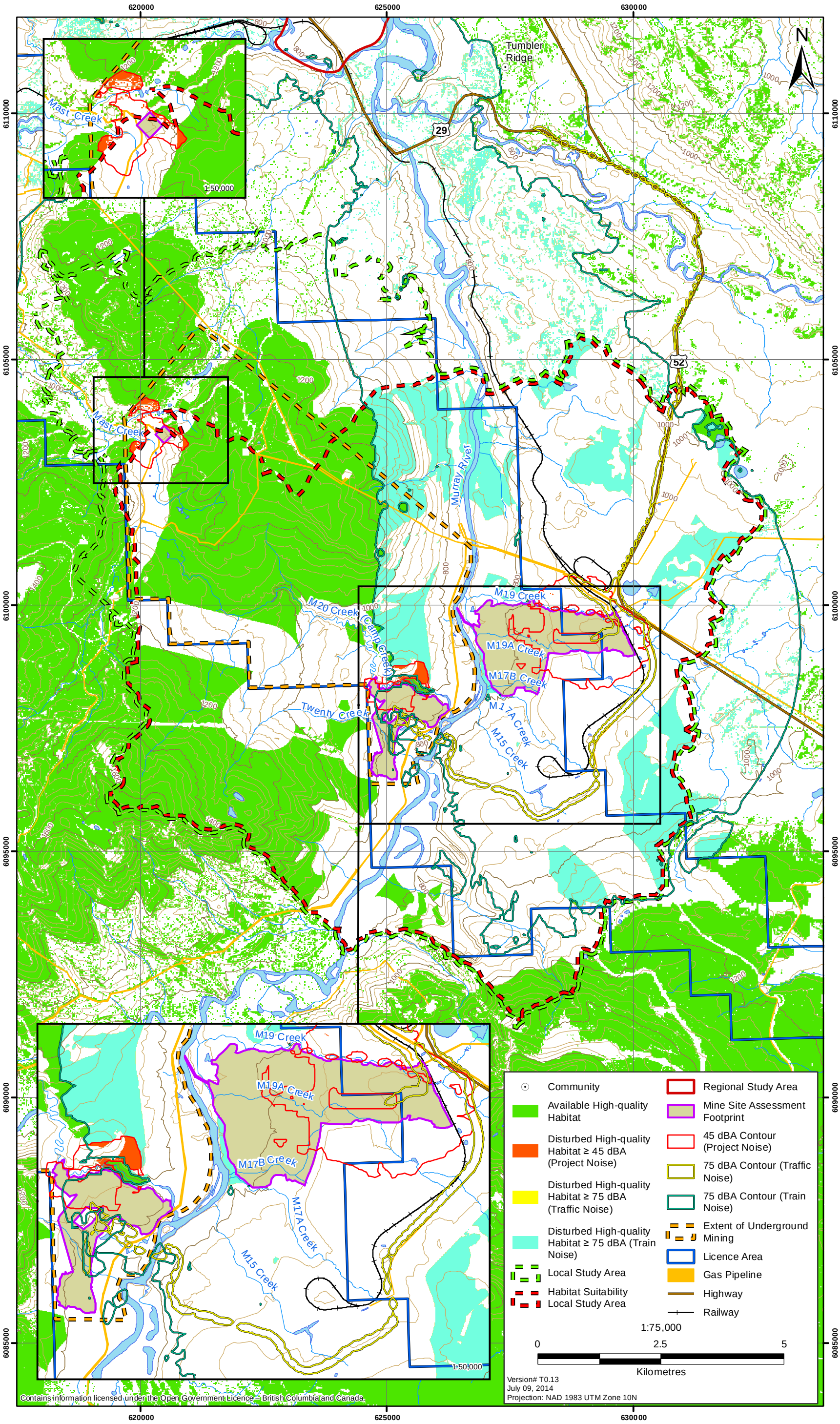


Figure 13.7-28

Grizzly Bear: Functional Habitat Loss of High-quality Habitat due to Noise - Operation



Instantaneous Train Noise: No Project-related trains are anticipated to run during Construction. During Operation, the total amount of high-quality grizzly bear habitat affected by elevated train noise levels (75 dBA Ln or greater) after accounting for high-quality habitat lost due to habitat loss and alteration (Section 13.7.9.1), and that is functionally lost to continuous Project noise and instantaneous traffic noise is 6,975 ha (6.0% of the high-quality habitat in the RSA) of which 1,456 ha are disturbed in the LSA accounting for 24.3% of the high-quality grizzly bear habitat in the LSA (Table 13.7-22; Figure 13.7-28).

Residual Effects of Sensory Disturbance for Grizzly Bear

The effect of sensory disturbance is not predicted to have a residual effect on grizzly bears. Grizzly bear home ranges cover a large area. Grizzly bear home range sizes have been estimated to range 18,700 ha for a male interior grizzly bear (MacHutchon, Himmer, and Bryden 1993; L. M. Ciarniello 2006). The overall functional loss of grizzly bear habitat due to daily Project noise is approximately 27 ha during operation, which is <0.01% of the home range of a female coastal grizzly bear, which tend to have smaller home range sizes. Habitat degradation due to vehicle noise is predicted to be negligible (1.7 ha).

Noise from rail traffic was evaluated as having a low-level disturbance effect on wildlife species. The total area where bears may have a disturbance effect is 6,977 associated with noise due to trains during Operation is less than 6% of the available grizzly bear habitat in the RSA. This disturbance will last for a few minutes during two round trips per day.

13.7.9.3 Disruption of Movement

Grizzly bears maintain large individual home ranges that include separate seasonal habitats, such as wetlands in early spring and alpine areas in the late summer. Travel routes within and between habitats are variable and in most cases not easily identifiable across the landscape. The greatest potential impact to bear movements is disruption of access to important seasonal habitats.

Research indicates that roads may act as barriers to grizzly bear movements, effectively isolating seasonal habitats. Female grizzly bears are particularly sensitive and avoid crossing large roads (Ross 2002; Waller and Servheen 2005). In contrast, low-usage roads can act as an attractant, offering high-quality vegetation forage along the roadside. An important consideration for grizzly bears is the amount of traffic on roads. When traffic volume rises above a threshold point (over 10 vehicles per hour for grizzly bears; Waller and Servheen 2005), bears may avoid a particular road, making it a barrier to movement. Irrespective of traffic, grizzly bears may still avoid areas within 100 m of roads, suggesting that even low levels of traffic can displace grizzly bears (McLellan and Shackleton 1988). Mueller (2001) also reported that bears used areas closer to roads during human inactive periods (6 p.m. to 7 a.m.) more often than during active periods (7 a.m. to 6 p.m.).

Grizzly bears have been shown to continue to cross roads when traffic volumes are less than 10 vehicles per hour (Waller and Servheen 2005). During Operation, the average traffic volume due to the Project will be less than 10 vehicles per hour along Highway 52, and along the approximately 12 km of access roads.

The Murray River valley functions as a movement corridor for grizzly bears (and other wildlife), and the Murray River Resource Management Zone was delineated in the Dawson Creek LRMP in part to

maintain this function. The presence of high-quality grizzly bear habitat in the RMZ facilitates movement through the area, particularly during the spring when grizzly bears seek snow free areas at lower elevations. A total of 1,658 ha of high-quality grizzly bear habitat occurs within the portion of the RMZ that lies within the RSA boundary, the majority of which is considered high value spring habitat (Table 13.7.-23; Figure 13.7-29). Similarly, high value spring habitat (584 ha) constitutes the majority of available high-quality habitat (629 ha) in the portion of the RMZ that lies within the LSA extent. When accounting for all types of disturbance, approximately 12%, 25%, and 31% of available spring, summer, and fall habitat in the Murray River RMZ portion of the RSA will potentially be affected. In the LSA, approximately one third of available high-quality spring, summer, and fall habitat in this portion of the RMZ may potentially be affected by collective disturbances.

Residual Effects of Disruption to Movement on Grizzly Bears

Uncertainties regarding the magnitude and extent of subsidence, the status of the local grizzly bear population, and the potential degree of disturbance in the movement corridor within the Murray River RMZ, particularly during spring, collectively are predicted to result in a residual effect on the movement of grizzly bears along the Murray River.

13.7.9.4 Direct Mortality

The potential sources of grizzly bear mortality in association with the Project will be vehicle collisions along Project roads (access, haul and service roads) and Highway 52. Grizzly bears tend to den at higher elevations; therefore, the destruction of den sites was not evaluated.

Direct mortality caused by vehicle collisions may occur along Project roads (access, haul, and service roads) and Highway 52. During spring, bears that have recently emerged from their dens often forage on roadside vegetation and carrion, and are typically more exposed to potential dangers. Between 1994 and 2013, there were 3 reported vehicle accidents with bears between Km 87 in LKI segment 1171 and Km 12 in LKI segment 1198 along Highway 52 within the RSA (average 1.5 bears/year; BC MOTI 2011); all occurred in September. There is no risk of vehicles colliding with grizzly bears in winter, as bears are in their dens.

Project-related vehicles will add to traffic on public highways and Project roads, increasing the probability of vehicle-bear collisions. High value spring, summer, and fall foraging habitat occurs along Twenty Creek, M20 Creek, and Mast Creek, which are in close proximity to an existing road network. Bears are likely to occupy these valleys and be at risk of vehicle-bear collisions; however, the rate of vehicle-wildlife collisions is heavily dependent on the speed of vehicles involved, with mortality rate increasing above 70 km/hr (Seiler 2005). Hence, vehicle-related mortality along the on-site Project roads is expected to be lower per km than on Highway 52, which is negligible.

Residual Effects for Bears due to Direct Mortality

Potential Project-related vehicle interactions with bears will be mitigated through adherence to road and traffic signs, and cutting vegetation low along access road ROWs to ensure visibility of animals. After mitigation, direct mortality is not expected and therefore, no residual effects are predicted.

Table 13.7-23. High-quality Grizzly Bear Habitat Lost, Altered, or Disturbed within the Murray River Resource Management Zone Corridor

Type of Habitat Alteration	Life History Phase	Murray River Corridor (within Regional Study Area)			Murray River Corridor (within Local Study Area)		
		High-quality Habitat Available (ha)	High-quality Habitat Lost/ Altered (ha)	% High-quality Habitat Lost/ Altered	High-quality Habitat Available (ha)	High-quality Habitat Lost/ Altered (ha)	% High-quality Habitat Lost/ Altered
Total High-quality Habitat within RMZ		1,658			629		
Spring High-quality Habitat within RMZ		1,568			584		
Summer High-quality Habitat within RMZ		315			257		
Fall High-quality Habitat within RMZ		231			231		
Habitat Loss due to Mine Site Assessment Footprint							
	Spring		102	6.5		102	17.5
	Summer		70.2	22.3		70.2	27.3
	Fall		69.2	14.2		69.2	30.0
	Total		107	6.4		107	17.0
Habitat Alteration due to Subsidence							
	Spring		73.6	4.7		73.6	12.6
	Summer		7.5	2.4		7.5	2.9
	Fall		3.3	0.7		3.3	1.4
	Total		79.2	4.8		79.2	12.6
Habitat Disturbance due to Continuous Project Noise (45 dBA)							
	Spring		8.6	0.5		8.6	1.5
	Summer		0.4	0.1		0.4	0.2
	Fall		0.03	0.01		0.03	0.01
	Total		9.1	0.5		9.1	1.4

All habitat loss and alteration calculations are for end of Operation when the largest amount of habitat is anticipated to be lost or altered.
All noise disturbance calculations are during Operation when continuous Project noise will occur for the longest time period.

13.7.9.5 Attractants

Grizzly bears are often attracted to odours from human activity sites such as industry construction camps, community dumps, and provincial and backcountry camping areas (McLellan 1990; Blood 2001, 2002; COSEWIC 2002b). This behaviour is problematic as these bears are more likely to become acclimated to the presence of people. Once a bear becomes habituated to either humans or food, the probability of a negative human-bear interaction increases (Herrero 1985; Peine 2001). Conflicts often negatively affect the survival of bears. In Yellowstone National Park, bears that came into conflict with humans had a higher probability of dying within a year of the conflict (Haroldson, Schwartz, and White 2005). If problem grizzly bears avoid conflict with humans for more than two years, their survival rate returns to that of bears with no known history of conflict with humans (Haroldson, Schwartz, and White 2005).

Problem bears pose a risk to human safety, which often requires their relocation or destruction (Gibeau and Herrero 1998). While relocation of habituated or food-conditioned bears reduces the chances of an immediate negative altercation, bears are moved into territories that are either occupied by other bears or have relatively less suitable habitat, leading to lower survival rates (Blanchard and Knight 1995; BC MOE 2001). In many cases, bears that are attracted to human activity centres and are perceived as a threat to life or property are destroyed. Approximately 588 of the 736 reported human-caused mortalities of grizzly bears (i.e., mortalities not associated with legal hunting) across BC from 1976 to 1999 were attributable to "defence of life and property" kills (COSEWIC 2002b). Recent statistics suggest up to 50 grizzly bears are killed every year in BC as a consequence of conflicts with humans (BC MOE 2001; Blood 2001).

The Waste Management Plan (Section 24.13) outlines mitigation to be implemented to reduce the attractiveness of Project infrastructure for bears and the consequent conflicts. This includes proper storage and removal of garbage and other wastes. All wastes will be stored inside buildings, bear-proof compounds, or in wildlife-proof containers, and all employees will receive training on safe disposal of wastes to avoid attraction (Section 24.13). In areas where mitigation measures are implemented, grizzly bears are able to maintain a high survival rate near human developments (L. M. Ciarniello 1997; H. Davis, Wellwood, and Ciarniello 2002).

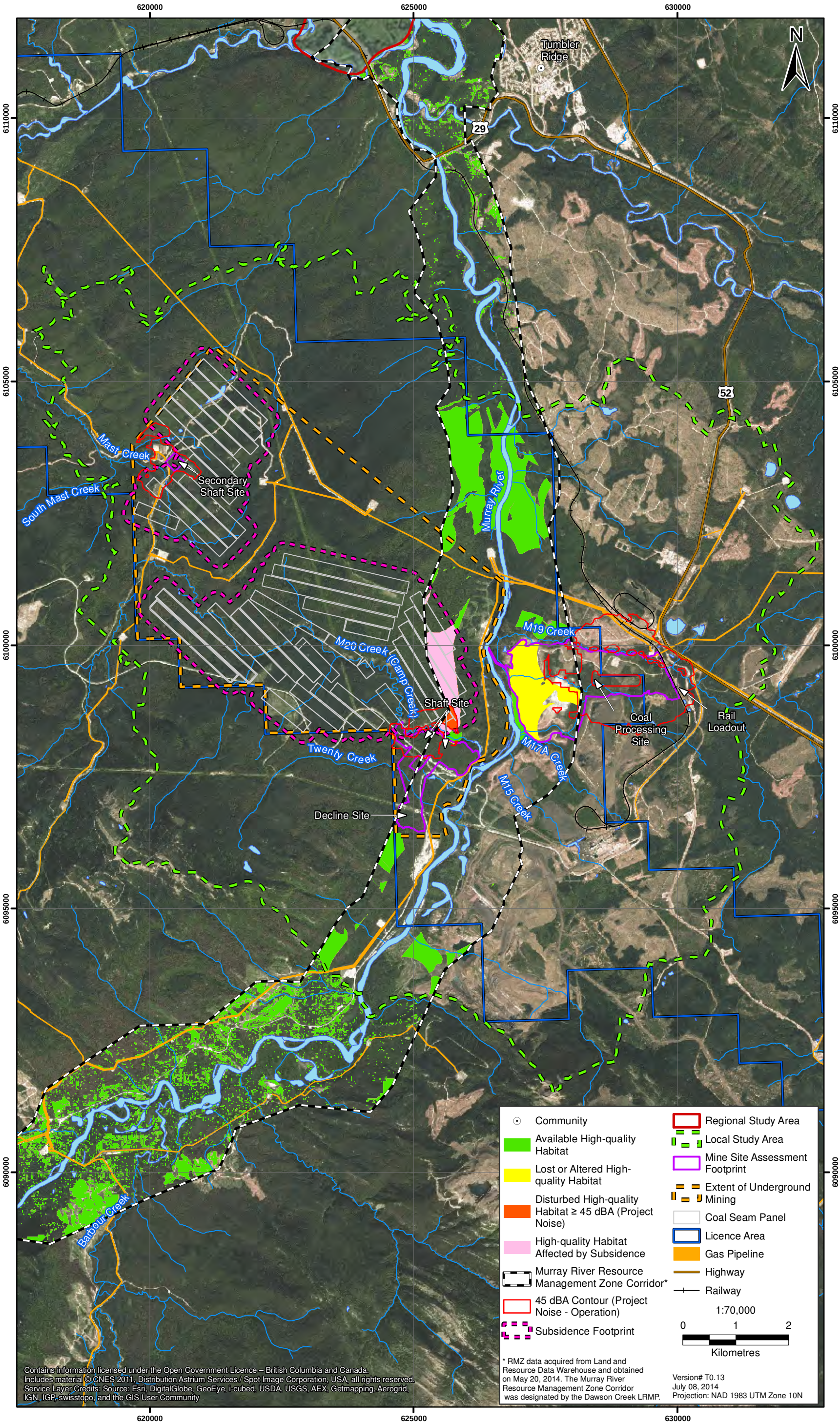
Closed roads or roads with little traffic are also frequently used as travel routes by grizzly bears. In addition, grizzly bears are attracted to road edges. These issues serve to increase the risk of bear-vehicle interactions. The Wildlife Management Plan (Section 24.12) outlines measures to reduce wildlife-vehicle interactions, such as low speed limits, road signs in wildlife habitats, removal of carrion along Project roads, and proper disposal of food wastes. Wildlife-vehicle and human-wildlife interactions will be reported and records compiled to help identify locations with high levels of wildlife conflicts, should they occur, to minimize the risk to bears.

13.7.10 Mitigation Measures for Grizzly Bear

The Wildlife Management Plan (Section 24.12) describes the mitigation and management activities that are designed to reduce or eliminate potential effects to wildlife. Mitigation measures specific to grizzly bear are described in the following sections.

Figure 13.7-29

High-quality Grizzly Bear Habitat Lost, Altered, or Disturbed within the Murray River Resource Management Zone Corridor



13.7.10.1 Mitigation for Habitat Loss and Alteration

The effects of habitat loss and alteration on all wildlife, including grizzly bears, will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). Additional mitigation measures for habitat loss and alteration are detailed in Decommissioning and Reclamation (Section 3.9). The potential effects of subsidence will be monitored as per the Subsidence Management Plan (Section 24.15). Mitigation for direct habitat loss and alteration on grizzly bear will include, but is not limited to:

- avoidance of important habitat where practical alternatives are available (e.g. habitat loss and alteration was minimized through Project design);
- no disruption to grizzly bear feeding in fish bearing streams; and
- re-vegetation of some reclaimed components during Decommissioning and Reclamation.

13.7.10.2 Mitigation for Sensory Disturbance

The effects of sensory disturbance on all wildlife, including grizzly bear will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effects of sensory disturbance to grizzly bear will be minimized by mitigating the effects noise (Section 24.3, Noise Management Plan). Guidelines will be followed to minimize the effects of noise on grizzly bear and other wildlife (Milko 1998a; BC MOE 2006a).

The following noise mitigation measures will be implemented and are not limited to:

- noise specifications will be considered when selecting equipment to purchase;
- vehicles will be maintained regularly;
- speed limits will be imposed for on-site Project roads;
- mufflers will be installed on vehicles and maintained;
- noise dampening measures will be applied where possible; and
- noise will be monitored periodically at various human and wildlife receptor locations, as part of the Noise Management Plan (Section 24.3) and mitigation strategies will be adjusted accordingly, if required. Noise monitoring locations will be at locations to enable confirmation of noise modelling and effects assessment.

13.7.10.3 Mitigation for Disruption of Movement

The effects of disruption to movement on all wildlife will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effect of disruption of movement will largely be mitigated by the same mitigation measures for habitat loss (Section 13.7.10.1) and sensory disturbance (Section 13.7.10.2). Additional mitigation measures for the disruption of movements for grizzly bear will include but are not limited to:

- wildlife will be given the right-of-way along access roads and the highway; and
- enforcement of speed limits along on-site Project roads.

13.7.10.4 Mitigation for Direct Mortality

The effects of direct mortality on all wildlife will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effect of direct mortality will largely be mitigated by the same mitigation measures for habitat loss (Section 13.7.10.1) and disruption of movement (Section 13.7.10.3).

Specifically, the effect of direct mortality to grizzly bear will be mitigated through the following measures:

- when clearing cannot be schedule outside the sensitive periods, a qualified on-site monitor will conduct a reconnaissance survey prior to clearing to identify active dens in high-quality denning habitat to identify areas where tree clearing will be prohibited and a forested buffer will be maintained around the identified active den site. If an active den is found (occupied by a furbearer or their young), and cannot be avoided or work must be undertaken within buffer areas, the relevant regulators will be consulted to develop appropriate strategies;
- adhering to speed limits along Project roads and on Highway 52;
- communicating locations of wildlife observed along roads;
- yielding to wildlife observed along roads; and
- collisions between Project vehicles and wildlife will be documented and will include information on the location of the collision along Project roads and the highways.

13.7.10.5 Mitigation for Attractants

The effects of attractants on all wildlife will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effect of attractants on grizzly bears will also be mitigated by adhering to the Waste Management Plan (Section 24.13), which will include mitigation measures to store and remove all food wastes and wildlife attractants (e.g., liquid solvents, lubricants).

The following mitigation measures will specifically reduce the effects of attractants to grizzly bears:

- wildlife awareness will be implemented by educating employees regarding grizzly bears and waste management;
- a policy of not feeding or intentionally attracting wild animals will be implemented;
- bear awareness training and response plans will be implemented;
- all waste will be stored inside buildings, bear-proof compounds, or in wildlife-proof containers;
- all workers will be educated on waste management policies that limit human-wildlife interactions and will assist in keeping the risk of encounters to a minimum;
- waste disposal facilities will be inspected for signs of wildlife presence (i.e., chew marks on waste, wildlife mediated waste dispersion, wildlife scat or tracks, etc.);

- monitoring of waste bins, incinerators and landfills will be conducted regularly. If evidence of wildlife presence or access to waste disposal facilities is detected, or a waste disposal compliance problem is detected, survey frequency will be increased. If no wildlife attraction or permit compliance issues are detected over a consecutive three month period, monitoring frequency will be reduced for waste bins, incinerators, and landfills;
- for each case where misdirected waste is observed, the location, date, and time of the observation, as well as the type and amount of waste will be recorded;
- if wildlife is observed interacting with waste, the species observed and number of individual animals will be recorded along with the behaviour and condition of the animal(s), and any damage to the property resulting from wildlife attraction to waste; and
- when monitoring identifies situations where wildlife are accessing waste, and waste disposal practices are not in compliance with permit requirements, a management response will be triggered. The response will assess the situation and determine the cause of the problem. Adaptive management will be developed on a case-by-case basis when waste misdirection is identified.

Residual Effects for Bears due to Attractants

After mitigation, the effect of attractants is predicted to result in a negligible effect which is not residual on grizzly bears. To minimize the effects of attractants to bears, Project activities will adhere to the Waste Management Plan (Section 24.13), which will include mitigation measures to store and remove all food wastes and wildlife attractants (e.g., liquid solvents, lubricants), erecting bear fences in appropriate areas and monitoring of the waste management plan. Mitigation measures such as site crew education in wildlife awareness and protocols in dealing with nuisance bears will also be implemented.

13.7.11 Key Effects on Furbearers

American fisher was chosen as a representative furbearer species for the environmental assessment because they are provincially blue-listed in BC and have associated management objectives in the Dawson Creek LRMP (BC ILMB 1999). Fisher were assessed for potential Project-related effects including habitat loss and alteration, sensory disturbance, disruption of movement, direct mortality, and attractants because these effects have the potential to create a residual effect on fisher populations.

Indirect mortality was scoped out of the assessment because these effects are not anticipated to interact with fisher. Indirect mortality of wildlife typically is a result of increased hunting pressure due to increased access to the area with the creation of new roads. No new roads are planned for the Project that will provide new access for hunters and therefore no increase in the area available to hunters is expected.

The potential effect of chemical hazards on fisher was scoped out of this assessment in Section 13.6.3.6. The major pathway of chemical uptake in fisher is from the ingestion of small prey species, who in turn feed on vegetation. Predicted concentrations of COPCs in soil had HQs below 1.0 thus COPCs in soil were screened out of the assessment (Section 18.8.3.1). No vegetation specific guidelines for COPCs are available, however, the soil quality guidelines are considered to be protective against effects to vegetation or higher trophic level consumers.

The potential residual effects considered in the assessment for fisher during Construction, Operation, Decommissioning and Reclamation, and Post Closure phases are summarized in Table 13.7-24, and described in Sections 13.7.11.1 to 13.7.11.6.

Table 13.7-24. Ranking Potential Effects on Furbearers

Project Components/ Physical Activities	Potential Effects on Furbearers					
	Habitat Loss and Alteration	Sensory Disturbance	Disruption of Movement	Direct Mortality	Attractants	Chemical Hazards
Construction						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	M	L	M	L	L	O
Shaft Site	O	L	O	O	O	O
Decline Site	O	L	O	O	O	O
Traffic and Transportation	O	L	L	L	O	O
Operation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	L	O
Shaft Site	O	O	O	O	L	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	M	L	M	L	L	O
Traffic and Transportation	O	L	L	L	O	O
Decommissioning and Reclamation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	L	L	L	O	O
Post-Closure						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	O	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	O	O	O	O	O

(-) *No spatial or temporal overlap.*

O *Spatial and temporal overlap, but no interaction anticipated; no further consideration warranted.*

L *Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; no monitoring required, no further consideration warranted.*

M *Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*

H *Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

13.7.11.1 Habitat loss and Alteration

This assessment evaluates the effects of habitat loss and alteration on fisher. To evaluate the potential effects of the proposed Project on fisher habitat, the RSA was mapped using habitat suitability models (Section 13.6.3.1). This assessment evaluates the effects of habitat loss and alteration on fisher for both birthing and living categories.

Fisher Habitat Requirements and Availability

Fisher depend on old forests that contain large trees, continuous cover, and coarse woody debris to provide denning and foraging habitat (Weir 2003; Weir and Almuedo 2010). These areas are particularly important during the winter as they host relatively high numbers of small mammals and snowshoe hares, which fisher take as prey (Weir 1995)Fisher require cavities in large trees for giving birth and rearing young during winter and early spring (Weir and Almuedo 2010). Given that a fisher's home range must provide all of its foraging, thermal and security cover, and resting and reproductive habitat needs throughout the year, habitat suitability modelling focused on fisher living requisite – all seasons.

Much of the high-quality habitat is within large contiguous riparian corridors along most of the major drainages across the RSA including both sides of the Murray River and Wolverine River valleys. For all living stages, 28,736 ha of high-quality habitat were identified within the RSA, 4,841 ha of which were in the LSA (Figure 13.7-30).

Fisher Habitat Loss and Alteration

Habitat Loss and Alteration due to the Mine Site Assessment Footprint

Of the 28,736 ha of the total high-quality fisher habitat identified in the RSA, a total of 300 ha will be lost or altered within the Mine Site Assessment Footprints. This is equivalent to 1.1% of the total high-quality fisher habitat (all seasons combined) available within the RSA, or 6.3% of that available in the LSA (Table 13.7-25). A greater proportion of habitat loss will occur for the birthing habitat (2.4% of available birthing habitat in the RSA and 9.3% of the available high-quality birthing habitat in the LSA) relative to the proportion of living habitat lost (1.2% of high-quality living habitat available in the RSA, and 6.8 of that available in the LSA) as a result of development of mine infrastructure within the Mine Site Assessment Footprints (Table 13.7-25; Figures 13.7-31 and 13.7-32). The loss of habitat will primarily occur where there are riparian and mature stands of forests adjacent to the Murray River in relatively low elevation areas. However, some of the habitat (31.5 ha or 24% of the Shaft and Decline Site) within the Shaft and Decline Site has already been cleared as part of the bulk sample permit.

Habitat Loss or Alteration due to Subsidence

After accounting for habitat lost due to the Mine Site Assessment Footprint, an additional 528 ha of high-quality fisher habitat (1.8% of high-quality habitat in the RSA, and 10.9% in the LSA) may be altered due to subsidence (Table 13.7-26). A similar proportion of living and birthing habitat will be potentially affected by subsidence (2.0 – 2.8% in the RSA, and 10.6 to 11.9% in the LSA; Table 13.7-26). Figure 13.7-33 illustrates the total high-quality fisher habitat that may be altered within the 200 m

buffer zone of the coal seam panels where the effect of subsidence is anticipated to occur. The relative risk of change to fisher high-quality habitat is depicted by the number of overlapping panels to be mined, based on the Project Description (Section 3.6), where high-quality fisher habitat occurs. There is greater risk of alteration with increasing number of mined panels.

Table 13.7-25. Fisher High-quality Habitat Loss and Alteration due to the Project Mine Site Assessment Footprint

Season	High-quality Habitat Lost and Altered (ha)	Regional Study Area		Local Study Area	
		Total High-quality Habitat (ha)	High-quality Habitat Lost/Altered (%)	Total High-quality Habitat (ha)	High-quality Habitat Lost/Altered (%)
Fisher Living Habitat	300	26,068	1.2	4,443	6.8
Fisher Birthing Habitat	300	12,265	2.4	3,241	9.3
Total Fisher Habitat	300	28,736	1.1	4,841	6.3

Table 13.7-26. High-quality Fisher Habitat Potentially Altered due to Subsidence

Season	Number of Panels Mined Vertically	Area of High-quality Habitat Potentially Altered (ha)	Regional Study Area		Local Study Area	
			Total High-quality Habitat [1] (ha)	High-quality Habitat Altered (%)	Total High-quality Habitat[1] (ha)	High-quality Habitat Altered (%)
Total Fisher Habitat						
	1	42.7				
	2	143				
	3	144				
	4	85				
	5	0.0				
	Total[1]	528	28,736	1.8	4,841	10.9
Fisher Living Habitat	Total[1]	528	26,068	2.0	4,443	11.9
Fisher Birthing Habitat	Total[1]	345	12,265	2.8	3,241	10.6

[1]*Total includes area within the 200 m buffer where all subsidence may occur*

It is unclear how habitat quality for fisher will change within the zone of subsidence, and additional high-quality habitat for fisher birthing and/or living may be created as a result of the effects of subsidence on the terrain, and not all high-quality fisher habitat within this area may be lost or altered. Thus, the assessment assumes a worst-case scenario whereby calculations are based only on high-quality fisher habitat that may be lost as a result of subsidence, but this is potentially an overestimate of actual habitat loss or alteration.

Figure 13.7-30
Fisher: Living Habitat in the Regional Study Area

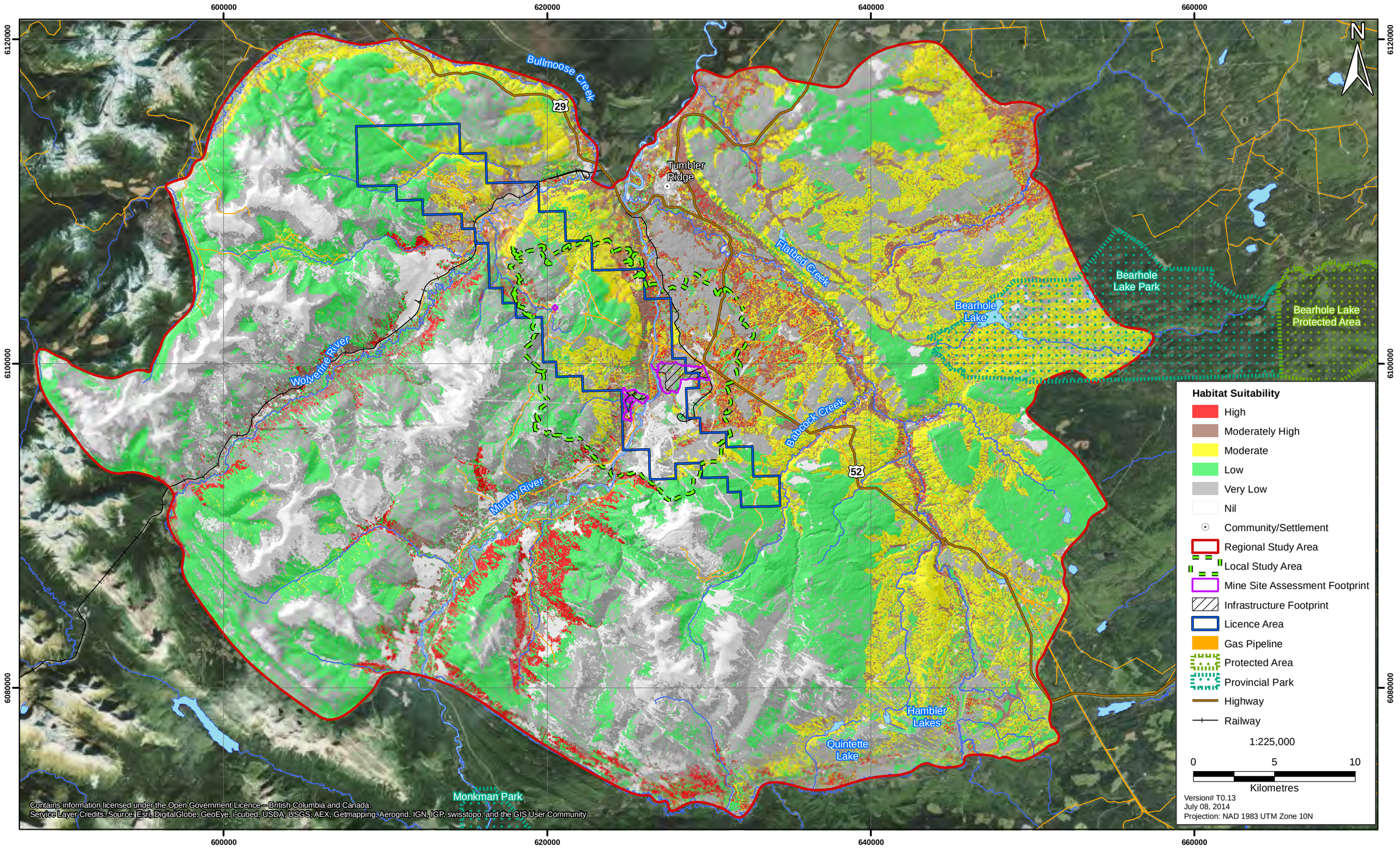


Figure 13.7-31

Fisher: Living Habitat Lost due to the Mine Site Assessment Footprint

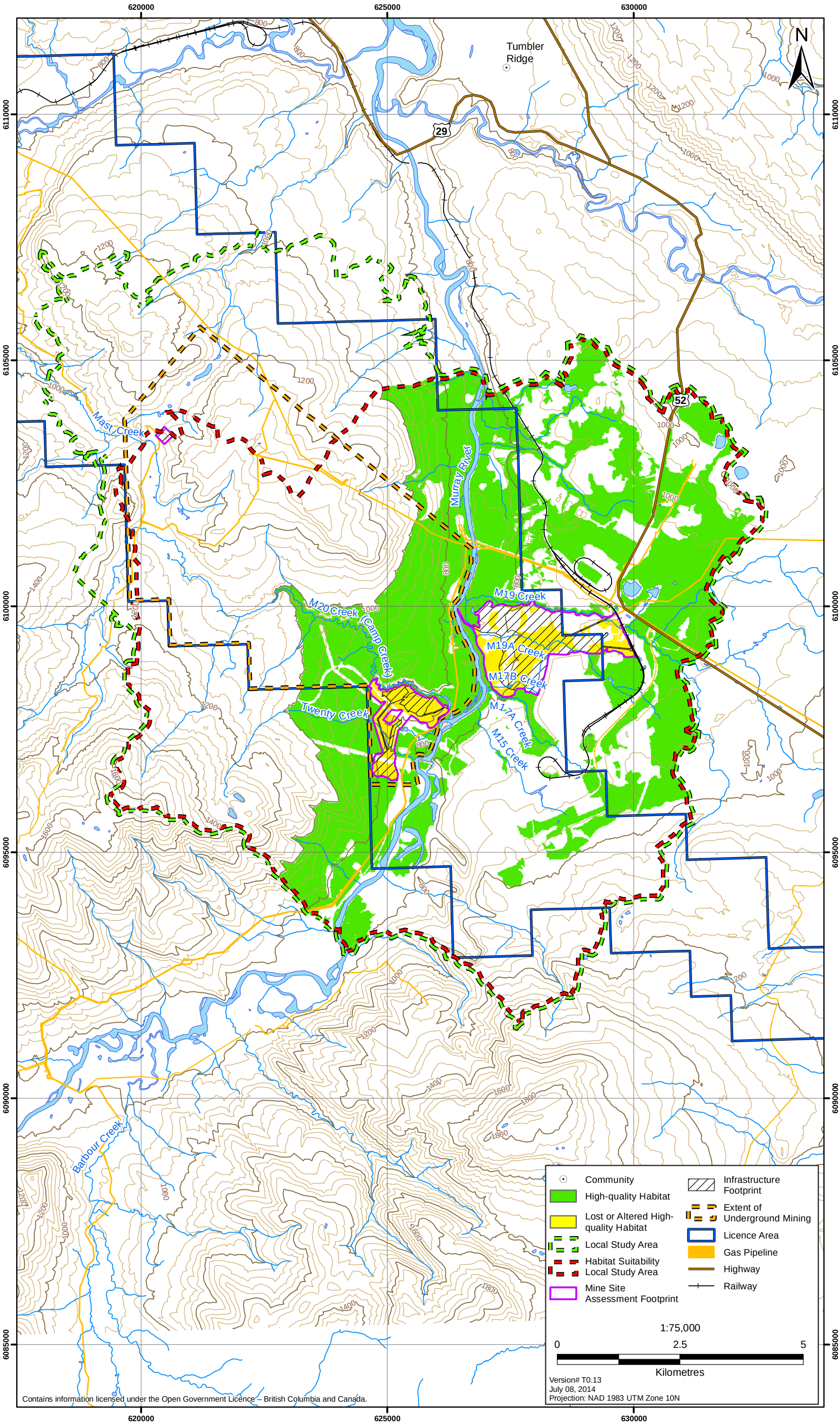


Figure 13.7-32

Fisher: Birthing Habitat Lost due to the Mine Site Assessment Footprint

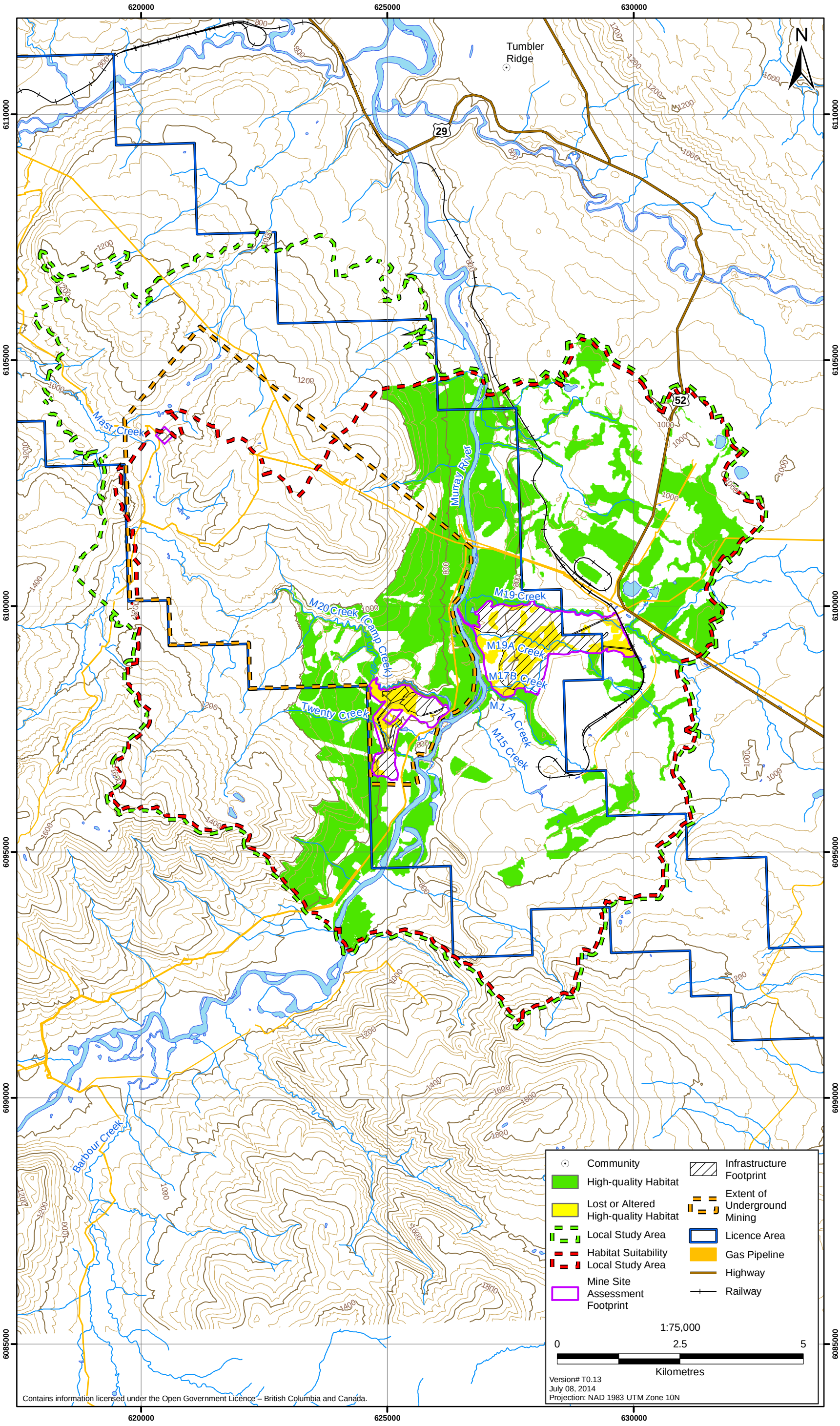
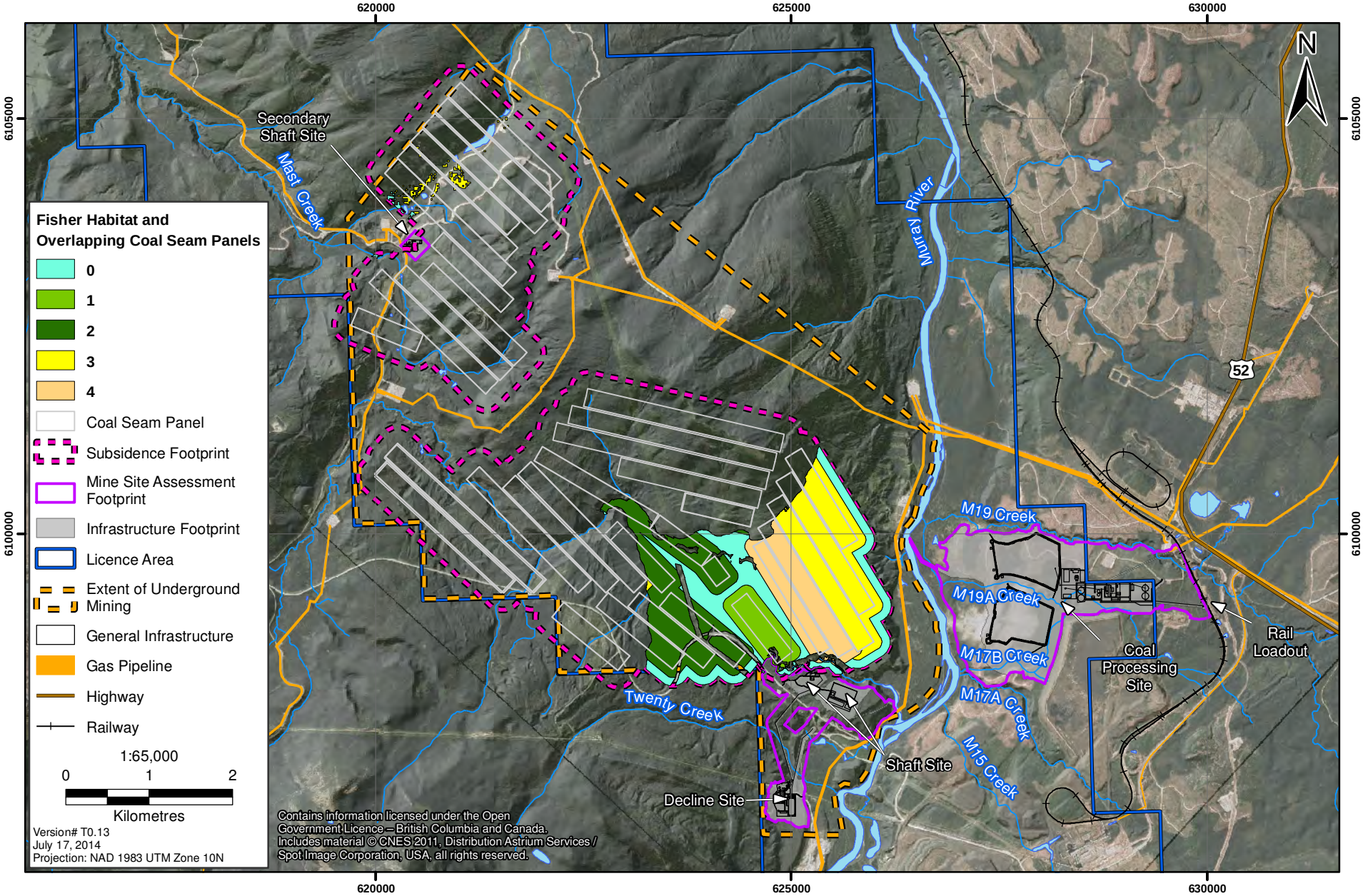


Figure 13.7-33
High-quality Fisher Habitat and Number of Overlapping Coal Seam Panels



Residual Effects of Habitat Loss and Alteration for Fisher

The effect of direct habitat loss and alteration, after considering mitigation measures to be implemented (Section 13.7.12.1), is predicted to result in a residual effect on fisher and furbearer populations. Fisher are blue-listed in BC, and the loss of forested habitat from human development has been identified as the main long-term threat to fisher populations throughout their range. A total of 304 ha of high-quality fisher habitat will be lost due to the Mine Site Assessment Footprint. An additional 528 ha may be altered due to the effects of subsidence in high-quality fisher habitat. Fisher home ranges in British Columbia vary between 890 ha for females and 1,800 ha for males. Thus, a loss of 304 ha within the Mine Site Assessment Footprint alone would be equivalent to 34.1% of a female home range and 16.9% of a male home range. With the inclusion of potential habitat alteration due to subsidence, a total of 832 ha could be altered which is equivalent to 93.5% of a female home range and 46.2% of a male home range. The density of fisher in British Columbia is fairly low (20.6 fisher/1,000 km2; Lofroth 2004) in high-quality habitat.

Reclamation of habitat at Decommissioning and Reclamation and Post Closure will be designed to restore habitat of comparable value to that lost during Project development and operation. However, the succession of reclaimed habitat to high-value old forest habitat will take many years and will only be targeted at areas that were previously forested. Therefore, habitat loss for fisher and furbearers is considered a residual effect.

13.7.11.2 Sensory Disturbance

Three types of noise effects were evaluated for potential effects on fisher:

1. Project noise at the Mine Site Assessment Footprint = functionally lost
2. Vehicle noise along the access roads = degraded habitat
3. Train noise along the train route = low level disturbance

This section evaluates the effects of sensory disturbance on fisher. Winter is the most critical time of year for fisher, and noise disturbance has the greatest potential to affect fisher in areas where Construction and Operation activities are proposed in close proximity to, or within high-quality fisher winter living habitat. Sensory disturbance during the birthing period may also affect fisher. Some Project-related activities are anticipated to occur during Construction and Operation and less so during Decommissioning and Reclamation and may overlap with the winter living (November 1 to February 29) and birthing period (March 1 to May 31) for fisher in identified high-quality habitat within the LSA and RSA (Tables 13.7-25 and 13.7-26).

Noise disturbance was calculated by overlaying noise contours for continuous Project-related noise, and instantaneous vehicle traffic and train traffic noise with results of habitat suitability models for fisher during the living and birthing seasons (Section 13.6.3.2).

Fisher Habitat Functionally Lost or Disturbed due to Noise

Continuous Project Noise: The total additional amount of high-quality fisher habitat functionally lost or disturbed by elevated Project-related noise (45 dBA or greater) is 11.3 ha (0.04% of the available high-quality habitat in the RSA and 0.2% of that in the LSA) during Construction (Table 13.7-27; Figure 13.7-34), and 108 ha (0.4% of the high-quality habitat in the RSA and 2.2% of that available in the LSA) during Operation (Table 13.7-27; Figure 13.7-35). The majority of Project noise during Construction will occur south of the Shaft and Decline Site and during Operation will occur north of the Shaft and Decline Site and north and south of the Coal Processing Plant (Coal Processing Site) on the eastern side.

Table 13.7-27. Functional Loss of High-quality Fisher Habitat due to Sensory Disturbance during Construction and Operation

Type of Sensory Disturbance	Project Phase	Regional Study Area			Local Study Area		
		High-quality Habitat Available (ha)	High-quality Habitat Functionally Lost (ha)	% High-quality Habitat Lost in RSA	High-quality Habitat Available (ha)	High-quality Habitat Functionally Lost (ha)	% High-quality Habitat Lost in LSA
		28,736			4,841		
Continuous Project Noise (45 dBA)							
	Construction		11.3	0.04		11.3	0.2
	Operation		108	0.4		108	2.2
Instantaneous Traffic Noise(75 dBA)							
	Construction		44.1	0.2		34.4	0.7
	Operation		39.4	0.1		29.6	0.6
Instantaneous Train Noise (75 dBA)							
	Construction		-	-		-	-
	Operation		7,231	25.2		3,124	64.5

Instantaneous Vehicle Traffic Noise: The total additional amount of high-quality fisher habitat which will be degraded by traffic noise (75 dBA or greater), during Construction is 44.1 ha in the RSA (0.2% of the high-quality habitat available in the RSA) and 34.4 ha in the LSA (0.7% of the high-quality habitat available in the LSA; Table 13.7-27; Figure 13.7-34). During Operation, the total additional amount of high-quality fisher habitat functionally lost or disturbed due to vehicle traffic noise is 39.4 ha in the RSA (0.1% of the available high-quality habitat in the RSA) and 29.6 ha in the LSA (0.6% of the high-quality habitat in the LSA; Table 13.7-27; Figure 13.7-35).

Instantaneous Train Noise: No Project-related trains are anticipated to run during Construction. During Operation, the total additional amount of high-quality fisher habitat where low-level disturbance effects may occur due to train noise (75 dBA or greater) is 7,231 ha in the RSA (25.2% of the available high-quality habitat in the RSA) and 3,124 ha in the LSA (64.5% of the high-quality habitat in the LSA; Table 13.7-27; Figure 13.7-35).

Residual Effects of Sensory Disturbance for Fisher

The area anticipated to have elevated continuous Project-related noise levels that may cause functional habitat loss are small (10-100 ha). These areas occur adjacent to and in the Murray River riparian corridor during both Construction and Operation as well as on the east side of the Coal Processing Site during Operation. Traffic noise is also predicted to result in a small area of degraded habitat due to disturbance.

Train noise, is predicted to have a low-level disturbance effect over a fairly large area, including 25% of the high-quality habitat in the RSA. Train noise is predicted to result in a low-level disturbance response. The train has been functioning for 30 years without any noticeable change in the fisher population in the RSA. Therefore, noise and disturbance are not predicted to result in a residual effect on fisher and other furbearers.

13.7.11.3 Disruption of Movement

Large tracts of treeless, early seral stage habitat can act as barriers for fisher movement (Hawley and Newby 1957; Gibilisco 1994). Fishers prefer forests with older seral stands and continuous canopy cover and they avoid open areas (Hawley and Newby 1957; Gibilisco 1994). Stands that provide rearing, resting, or foraging habitat are also used for movement (Weir and Almuedo 2010). Fisher are sensitive to extensive habitat loss and fragmentation resulting from clearing activities, which can impede fisher from dispersing through the landscape (Weir and Almuedo 2010). Habitats that have >50% overhead cover from the combination of trees and shrubs provide sufficient movement habitat for fisher (Weir and Almuedo 2010).

Project-related activities that are most likely to contribute to disruption of movement for fishers include habitat that will be lost to clearing activities during Construction and Operation. Habitat loss and alteration are discussed in Section 13.7.11.1. This section evaluates the potential for disruption of movement as a result of habitat loss and alteration.

A large band of fisher high-quality living habitat was modelled along the Murray River corridor primarily on the western side of the river (Figure 13.7-36; Table 13.7-28). Some habitat loss or alteration will occur within this corridor during Construction and Operation as a result of the development of the Project infrastructure within the Mine Site Assessment Footprints primarily in the Shaft and Decline Site (Figures 13.7-36). In addition, some habitat alteration within this corridor on the western side of the Murray River may occur as a result of subsidence (Figure 13.7-36), but it isn't understood how alteration due to subsidence might affect habitat quality for fisher. A small proportion of habitat within this corridor may also be functionally lost or disturbed due to noise, primarily during Operation (Figure 13.7-36). Taken together, this loss or alteration of habitat as a result of Construction and Operation of the mine is anticipated to result in an effect to the use of this corridor for movement as this corridor will be affected by habitat loss, alteration, and disturbance due to noise.

Another area of habitat loss or alteration will occur in the Coal Processing Site, east of the Murray River habitat corridor (Figure 13.7-36); however this area is directly adjacent to an area rated as nil-quality habitat for fisher and falls within an area that is already largely fragmented habitat.

Figure 13.7-34

Fisher: Functional Habitat Loss of High-quality Habitat due to Noise - Construction

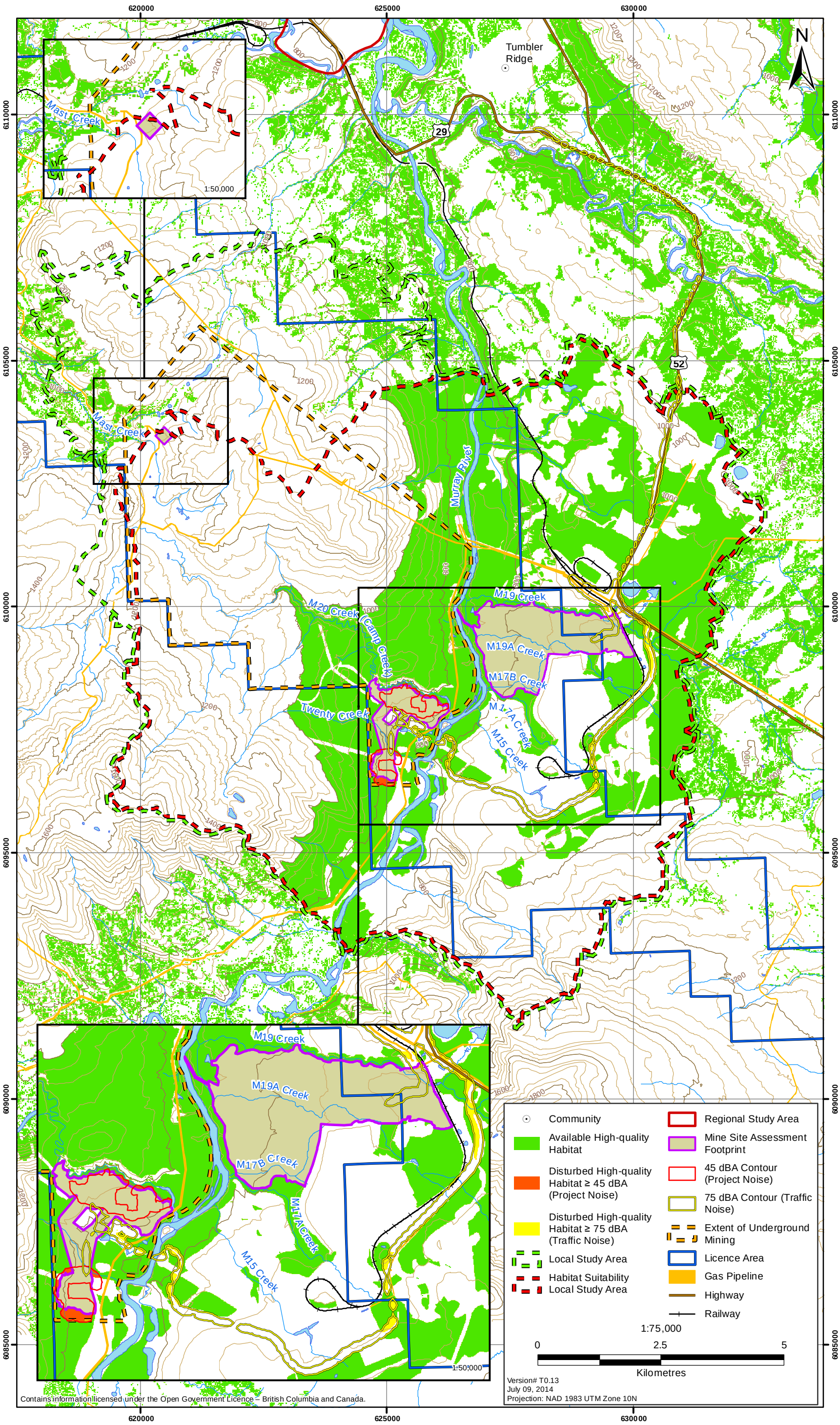


Figure 13.7-35

Fisher: Functional Habitat Loss of High-quality Habitat due to Noise - Operation

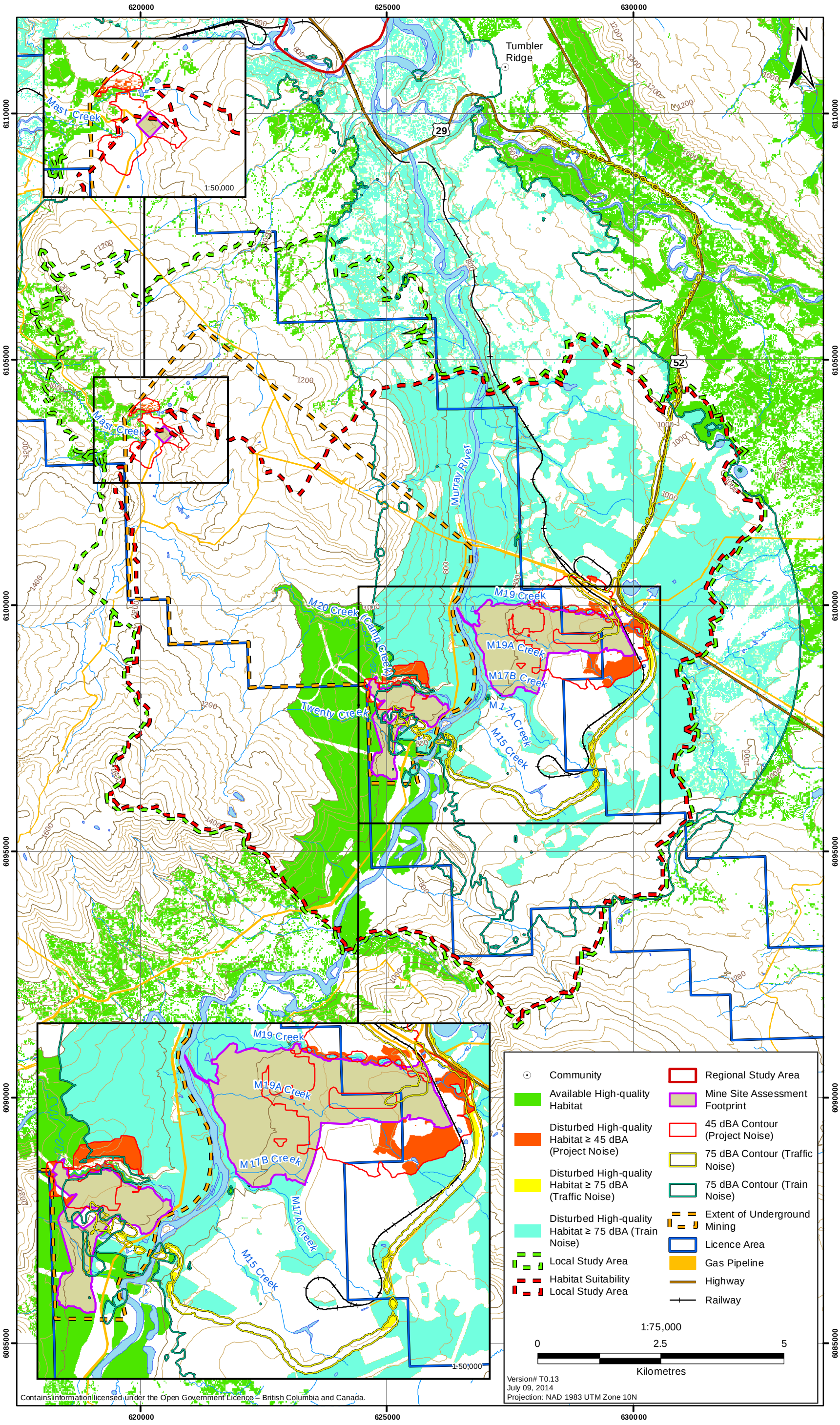


Figure 13.7-36

High-quality Fisher Habitat Lost, Altered, or Disturbed within the Murray River Resource Management Zone Corridor

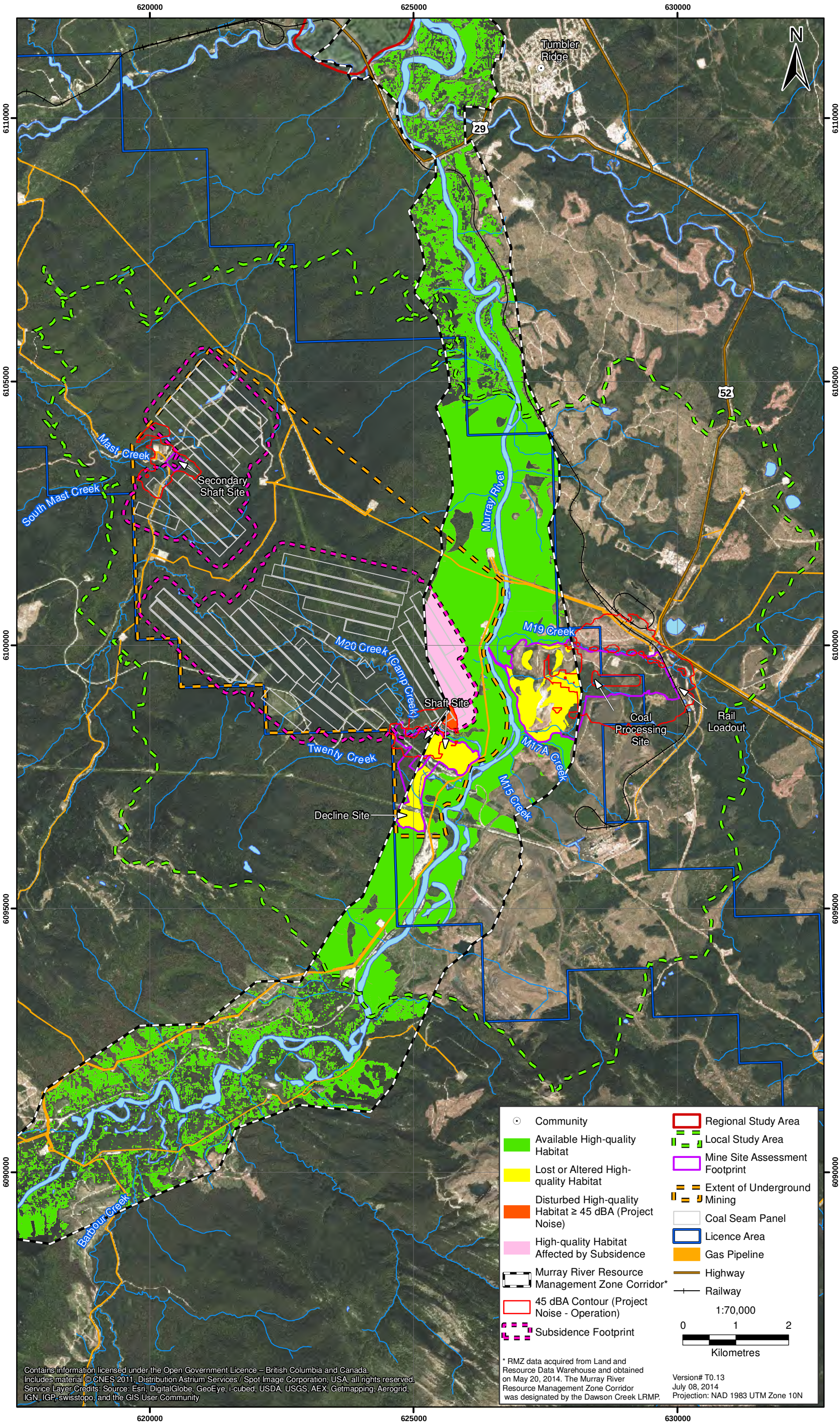


Table 13.7-28. High-quality Fisher Habitat Lost, Altered, or Disturbed within the Murray River Resource Management Zone Corridor

Type of Habitat Alteration	Life History Phase	Murray River Corridor (within Regional Study Area)			Murray River Corridor (within Local Study Area)		
		High-quality Habitat Available (ha)	High-quality Habitat Lost/ Altered (ha)	% High-quality Habitat Lost/ Altered	High-quality Habitat Available (ha)	High-quality Habitat Lost/ Altered (ha)	% High-quality Habitat Lost/ Altered
Total High-quality Habitat within RMZ		3,679			1,834		
Birthing High-quality Habitat within RMZ		2,558			1,536		
Living High-quality Habitat within RMZ		3,679			1,834		
Habitat Loss due to Mine Site Assessment Footprint							
	Birthing		134	5.2		134	7.3
	Living		197	5.4		197	10.7
	Total		197	5.4		197	10.7
Habitat Alteration due to Subsidence							
	Birthing		111	4.3		111	6.1
	Living		144	3.9		144	7.9
	Total		144	3.9		144	7.9
Habitat Disturbance due to Continuous Project Noise (45 dBA)							
	Birthing		2.3	0.1		2.3	0.1
	Living		9.5	0.3		9.5	0.5
	Total		9.5	0.3		9.5	0.5

All habitat loss and alteration calculations are for end of Operation when the largest amount of habitat is anticipated to be lost or altered.
All noise disturbance calculations are during Operation when continuous Project noise will occur for the longest time period.

Residual Effects of Disruption of Movement for Fisher

The effect of disruption to movement is anticipated to have a residual effect on fisher. The Murray River Riparian Management Corridor Zone has been identified as a major movement corridor for mammals by the Dawson Creek LRMP. High-quality fisher habitat was identified for both the birthing and living seasons for fisher within this corridor (Section 13.5.3.1 and Section 13.7.11.1). The combination of habitat loss in the Mine Site Assessment Area, alteration in the subsidence area and disturbance are predicted to result in a residual effect of reduced movement along the Murray River, despite mitigation.

Mitigation strategies will be implemented to address disruption of movement concerns for fisher (Section 13.7.12.3; Section 24.12, Wildlife Management Plan). During Decommissioning and Reclamation and Post-Closure, provisions will be made for re-establishing habitat to high-value old growth forest of comparable value to that lost during Project development and operation in areas such as the Murray River corridor (Section 3.9; Decommissioning and Reclamation).

13.7.11.4 Direct Mortality

This section evaluates the effects of direct mortality as a result of Project-related activities to fisher. The primary sources of direct mortality to wildlife as a result of Project activities are typically associated with clearing activities for the development of Project infrastructure during Construction, and vehicle-related mortalities along Project and access roads.

Clearing activities for Project infrastructure will be conducted in the Mine Site Assessment Footprints, which contains some high-quality fisher birthing habitat. There is some potential for destruction or abandonment of maternal and natal dens due to clearing, and pre-clearing surveys will be conducted if clearing is conducted during the denning period.

The Project site will be primarily accessed via Highways 52 and 29. No road mortalities to fisher were reported in British Columbia by the BC Ministry of Transportation (District 8, which includes the Project RSA) between 1988 and 2007 (Sielecki 2010), although, vehicle-related mortalities, particularly for smaller animals are under-reported (Sielecki 2004b). Mitigation measures will be in place to reduce the effects of direct mortality on fisher and other furbearers as a result of vehicle-related mortality on the project access road (Section 13.7.12.4).

Residual Effects of Direct Mortality for Fisher

The effect of direct mortality is not predicted to result in a residual effect on fisher. To reduce fisher mortality along on-site on Project roads, speed limits will be implemented. Incidents, if they occur, will be reported. To prevent direct mortality of fisher during site clearing activities, where possible, clearing activities will be scheduled outside of the birthing and rearing periods which occurs from March 1 to May 31 when fisher are within denning habitat (low elevation older growth forests). If this is unfeasible, pre-clearing surveys will be conducted prior to clearing activities to identify active den sites. With mitigation, Project-related mortality is unlikely to contribute to population-level effects on fisher and is not predicted to result in a residual effect.

13.7.11.5 Attractants

Fisher and other furbearers may be attracted to Project features by odours, shelter, food, and prey (Ruggiero et al. 1994). Fisher may be attracted to human waste and small rodent populations within Project facilities. Fisher may also seek out structures for cover and denning (Hoylan, Jones, and Raphael 1998). Fisher presence at Project facilities typically do not present a risk to human safety; however, they become habituated and may become injured or ingest harmful materials.

During Construction and Operation, the Project will create infrastructure, human waste (e.g. food waste) and may store chemicals (such as fuel, oils, etc.) for use in mine development and operation that may attract fisher and other furbearers. Mitigation measures will be in place to reduce the effects of attractants on fisher and other furbearers (Section 13.7.12.5).

Residual Effects of Attractants for Fisher

Attractants are not predicted to result in a residual effect on local fisher populations. To minimize the effects of attractants to fisher, Project activities will adhere to the Waste Management Plan (Section 29.17), which will include mitigation measures to store and remove all food wastes and wildlife attractants (e.g., liquid solvents, lubricants). Monitoring will be conducted with adaptive management to ensure long-term effective elimination of attractants. Fisher will be prevented from accessing infrastructure with exclusion measures such as building skirting, and effectiveness of this mitigation will be monitored regularly. Wildlife awareness will also be implemented by educating employees regarding wildlife and waste management. In addition, fisher are anticipated to avoid project areas with human disturbance activities. Thus after mitigation, a residual effect is not anticipated to occur for fisher from Project attractants.

13.7.12 Mitigation Measures for Furbearers

The Wildlife Management Plan (Section 24.12) describe the mitigation and management activities that are designed to reduce or eliminate potential effects to wildlife. Mitigation measures specific to furbearers are described in the following sections.

13.7.12.1 Mitigation for Habitat Loss and Alteration

The effects of habitat loss and alteration on all wildlife, including furbearers will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). Additional mitigation measures for habitat loss and alteration are detailed in Decommissioning and Reclamation (Section 3.9). The potential effects of subsidence will be monitored as per the Subsidence Management Plan (Section 24.15). Mitigation for direct habitat loss and alteration on furbearers will include, but is not limited to:

- avoidance of important habitat where practical alternatives are available (e.g. habitat loss and alteration was minimized through Project design);
- no destruction or disruption of active fisher or marten dens during site clearing in the construction phase and during Construction and Operation; and
- re-vegetation of some reclaimed components during Decommissioning and Reclamation.

13.7.12.2 Mitigation for Sensory Disturbance

The effects of sensory disturbance on all wildlife, including fisher will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effects of sensory disturbance to fisher and other furbearers will be minimized by mitigating the effects noise (Section 24.3, Noise Management Plan). Guidelines will be followed to minimize the effects of noise on furbearers and other wildlife (Milko 1998a; BC MOE 2006a).

The following noise mitigation measures will be implemented and are not limited to:

- noise specifications will be considered when selecting equipment to purchase;
- vehicles will be maintained regularly;
- speed limits will be imposed for on-site roads;
- mufflers will be installed on vehicles and maintained;
- noise dampening measures will be applied where possible; and
- noise will be monitored periodically at various human and wildlife receptor locations, as part of the Noise Management Plan (Section 24.3) and mitigation strategies will be adjusted accordingly, if required. Noise monitoring locations will be at locations to enable confirmation of noise modelling and effects assessment.

13.7.12.3 Mitigation for Disruption of Movement

The effects of disruption to movement on all wildlife will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effect of disruption of movement will largely be mitigated by the same mitigation measures for habitat loss (Section 13.7.12.1) and sensory disturbance (Section 13.7.12.2). Additional mitigation measures for the disruption of movements for fisher and furbearers will include but are not limited to:

- wildlife will be given the right-of-way along access roads and the highway; and
- enforcement of speed limits along on-site Project roads.

13.7.12.4 Mitigation for Direct Mortality

The effects of direct mortality on all wildlife will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effect of direct mortality will largely be mitigated by the same mitigation measures for habitat loss (Section 13.7.12.1) and disruption of movement (Section 13.7.12.3).

Specifically, the effect of direct mortality to furbearers will be mitigated through the following measures:

- scheduling vegetation clearing activities outside of sensitive periods (e.g., fisher and marten birthing and denning period (March 1 to May 31), where feasible;
- when clearing cannot be schedule outside the furbearer sensitive periods, a qualified on-site monitor will conduct a reconnaissance survey prior to clearing to identify active furbearer

dens in high-quality denning habitat to identify areas where tree clearing will be prohibited and a forested buffer will be maintained around the identified active den site. If an active den is found (occupied by a furbearer or their young), and cannot be avoided or work must be undertaken within buffer areas, the relevant regulators will be consulted to develop appropriate strategies;

- yielding to speed limits along on-site Project roads and on Highways 52 and 29;
- communicating locations of wildlife observed along roads;
- yielding to wildlife observed along roads; and
- collisions between Project vehicles and wildlife will be documented and will include information on the location of the collision along Project roads and the highways.

13.7.12.5 Mitigation for Attractants

The effects of attractants on all wildlife will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effect of attractants on furbearers will also be mitigated by adhering to the Waste Management Plan (Section 24.13), which will include mitigation measures to store and remove all food wastes and wildlife attractants (e.g., liquid solvents, lubricants).

The following mitigation measures will specifically reduce the effects of attractants to furbearers:

- furbearers will be prevented from accessing infrastructure with exclusion measures such as building skirting that will be monitored regularly for effectiveness;
- wildlife awareness will be implemented by educating employees regarding furbearers and waste management;
- no feeding of or intentionally attracting wild animal policies will be implemented;
- all waste will be stored inside buildings, wildlife-proof compounds, or in wildlife-proof containers;
- all workers will be educated on waste management policies that limit human-wildlife interactions and will assist in keeping the risk of encounters to a minimum;
- waste disposal facilities will be inspected for signs of wildlife presence (i.e., chew marks on waste, wildlife mediated waste dispersion, wildlife scat or tracks, etc.);
- monitoring of waste bins, incinerators and landfills will be conducted regularly. If evidence of wildlife presence or access to waste disposal facilities is detected, or a waste disposal compliance problem is detected, survey frequency will be increased. If no wildlife attraction or permit compliance issues are detected over a consecutive three month period, monitoring frequency will be reduced for waste bins, incinerators, and landfills;
- for each case where misdirected waste is observed, the location, date, and time of the observation, as well as the type and amount of waste will be recorded;

- if wildlife is observed interacting with waste, the species observed and number of individual animals will be recorded along with the behaviour and condition of the animal(s), and any damage to the property resulting from wildlife attraction to waste; and
- when monitoring identifies situations where wildlife are accessing waste, and waste disposal practices are not in compliance with permit requirements, a management response will be triggered. The response will assess the situation and determine the cause of the problem. Adaptive management will be developed on a case-by-case basis when waste misdirection is identified.

13.7.13 Key Effects on Bats

Bats were assessed for potential Project-related effects. Habitat loss and alteration, sensory disturbance, direct mortality, and attractants were considered for the effects assessment because those effects have the potential to interact with bats and to result in a residual effect on bat populations. The effects of disruption of movement, indirect mortality, and chemical hazards were scoped out of this assessment because they were determined to have no interaction with bats.

Disruption of movement is not considered a potential effect for bats, as this species can avoid infrastructure by flying around or over obstacles. Roads can act as barriers to bat movement (Bat Conservation Fund 2008, Berthinussen and Altringham 2012); however no new roads that provide access for the public will be constructed as a result of the Project.

Indirect mortality is not considered a potential effect for bats because the primary source of indirect mortality identified for wildlife VCs in association with Project development is increased harvesting pressure, and bats are not hunted or trapped.

The potential effect of chemical hazards on bats was scoped out of this assessment in Section 13.6.3.6. The major pathway of chemical uptake in bats is from the ingestion of prey up the food web (e.g. insects). Insect prey would only achieve elevated concentrations of COPCs from the environmental media in which they live and forage. Since predicted concentrations in soil had HQs below 1.0 thus COPCs in soil were screened out of the assessment (Section 18.8.3.1). No vegetation specific guidelines for COPCs are available, however, the soil quality guidelines are considered to be protective against effects to vegetation or higher trophic level consumers. Since predicted soil concentrations are anticipated to be below an HQ of 1.0, uptake of COPCs from vegetation that insects may feed on were also screened out of the assessment. While M19A Creek and the wetland habitat between the Coal Processing Site and the Murray River are anticipated to exceed water quality guidelines (for the protection of wildlife) for selenium, selenium primarily affects egg-laying vertebrates; thus elevated concentrations of selenium in bats from ingestion of insect prey over waterbodies that may exceed water quality guidelines are not anticipated to result in toxicological effects in bats. Thus, COPC uptake from water into prey and up the food web through bioaccumulation processes was scoped out of the assessment for bats.

The potential residual effects considered in the assessment for bats during Construction, Operation, Decommissioning and Reclamation, and Post Closure phases are summarized in Table 13.7-29, and described in Sections 13.7.13.1 to 13.7.13.4.

Table 13.7-29. Ranking Potential Effects on Bats

Project Components/ Physical Activities	Potential Effects on Bats					
	Habitat Loss and Alteration	Sensory Disturbance	Disruption of Movement	Direct Mortality	Attractants	Chemical Hazards
Construction						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	L	L	O	L	L	O
Shaft Site	O	L	O	O	O	O
Decline Site	O	L	O	O	O	O
Traffic and Transportation	O	L	O	L	O	O
Operation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	L	O
Shaft Site	O	O	O	O	L	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	L	L	O	L	L	O
Traffic and Transportation	O	L	O	L	O	O
Decommissioning and Reclamation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	L	O	L	O	O
Post-Closure						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	O	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	O	O	L	O	O

(-) *No spatial or temporal overlap*

O *Spatial and temporal overlap, but no interaction anticipated; no further consideration warranted.*

L *Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; no monitoring required, no further consideration warranted.*

M *Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*

H *Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

13.7.13.1 Habitat Loss and Alteration

This assessment evaluates the effects of habitat loss and alteration on bats, in particular maternal roosting sites which have been identified as an important habitat feature for bat populations (Kunz 1982). Suitable habitat for roosting bats was captured in the fisher birthing habitat suitability mapping – essentially old-growth conifer forests - low elevation, moist sites with mature, predominately coniferous habitat with occasional large aspen or cottonwood trees in structural stages 5, 6, and 7 (EDI 2012). These features are similar to those used for maternal roosting by bats (D. W. Nagorsen and Brigham 1995; Ormsbee 1996; Sasse and Pekins 1996; Grindal, Morissette, and Brigham 1999; Vonhof and Wilkinson 1999).

Caves are an important habitat feature as hibernacula (i.e., where bats overwinter), since they can support large populations. Caves are typically associated with karst (limestone) topography. Geological mapping indicates that limestone is present in the RSA, but outside of the LSA. The Spray River Group – Whitehorse formation is a limestone bearing formation that overlaps with the south western portion of the RSA (Figure 13.7-37 and Figure 13.7-38). There is little information available as to whether this formation contains the appropriate thermal properties and structures to support bats. Regional surveys for bats have not been conducted in northeastern British Columbia (D. W. Nagorsen, Bryant, A. Kerridge, D. Roberts, G. 1993).

Habitat mapping for fisher birthing identified 14,832 ha as high-quality bat maternal roosting habitat in the RSA (Figure 13.7-37) and 3,419 ha in the LSA (Figure 13.7-38). Areas were primarily identified within low elevation, large contiguous riparian corridors along the Murray River and in the area between the Mine Assessment Footprint and Flatbed Creek. Within the LSA, the majority of high-quality habitat was identified on both sides of the Murray River, and on the north and central east sides of the LSA.

<u>Habitat Loss and Alteration due to the Mine Site Assessment Footprint</u>

Of the 14,832 ha of the total potential suitable bat maternal roosting habitat identified within the RSA, a total of 228 ha will be lost within the Mine Site Assessment Footprints, which is 1.5% of the roosting habitat in the RSA, or 6.6% of habitat in the LSA (Figure 13.7-39; Table 13.7-30) The Mine Site Assessment Footprints are primarily located in areas with limited mature forest capable of supporting maternal roosting sites.

Table 13.7-30. Bat Suitable Maternal Roosting Habitat Loss and Alteration due to the Project Mine Site Assessment Footprint

		Regional Study Area		Local Study Area	
Season	Habitat Lost and Altered in Mine Site Assessment Footprint (ha)	Total Suitable Habitat (ha)	Suitable Habitat Lost/Altered (%)	Total Suitable Habitat (ha)	Suitable Habitat Lost/Altered (%)
Bat Maternal Roosting Habitat	228	14,832	1.5	3,419	6.6

Figure 13.7-37
Bat: Maternal Roosting Habitat in the Regional Study Area

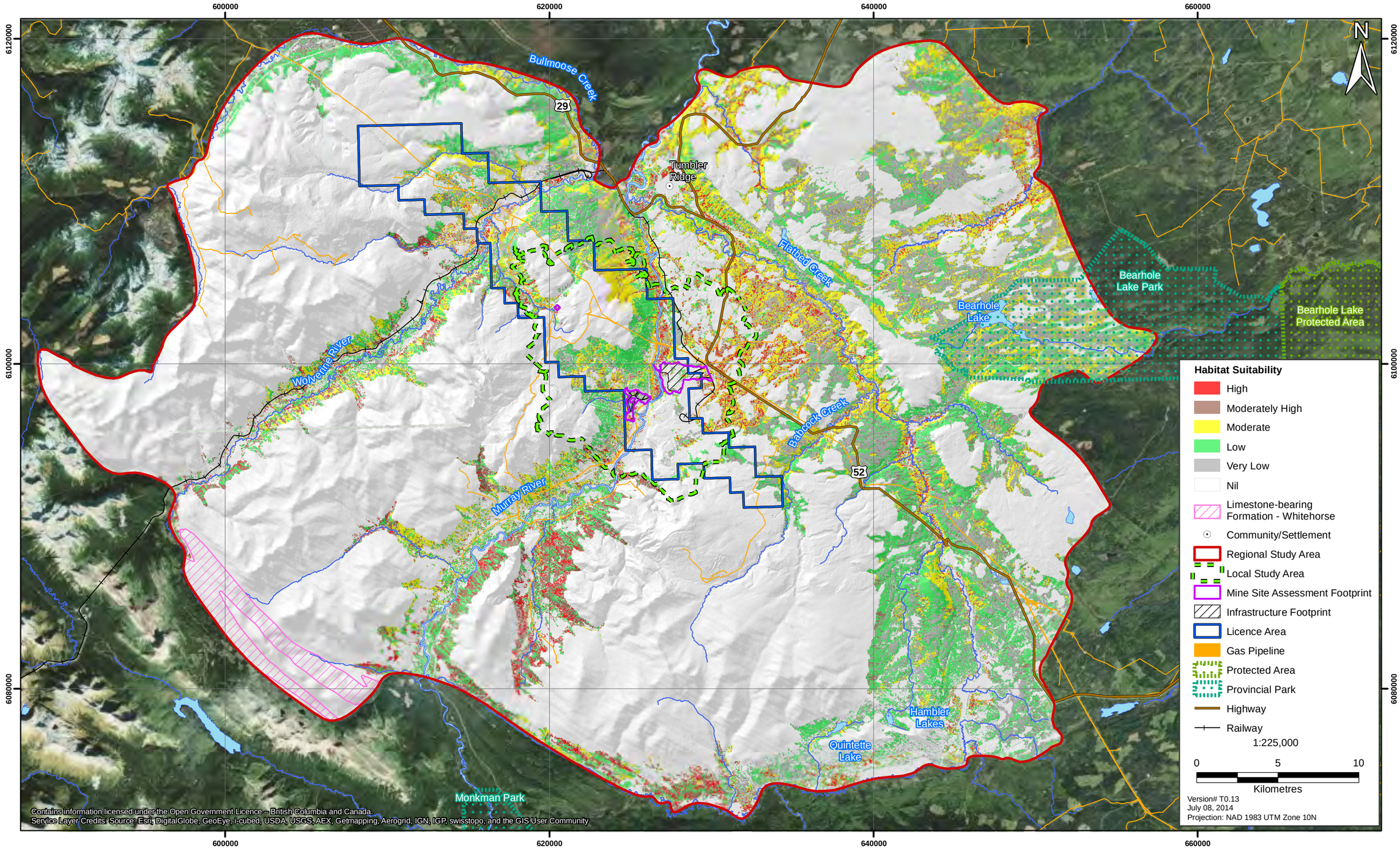


Figure 13.7-38

Bat: Maternal Roosting Habitat in the Local Study Area

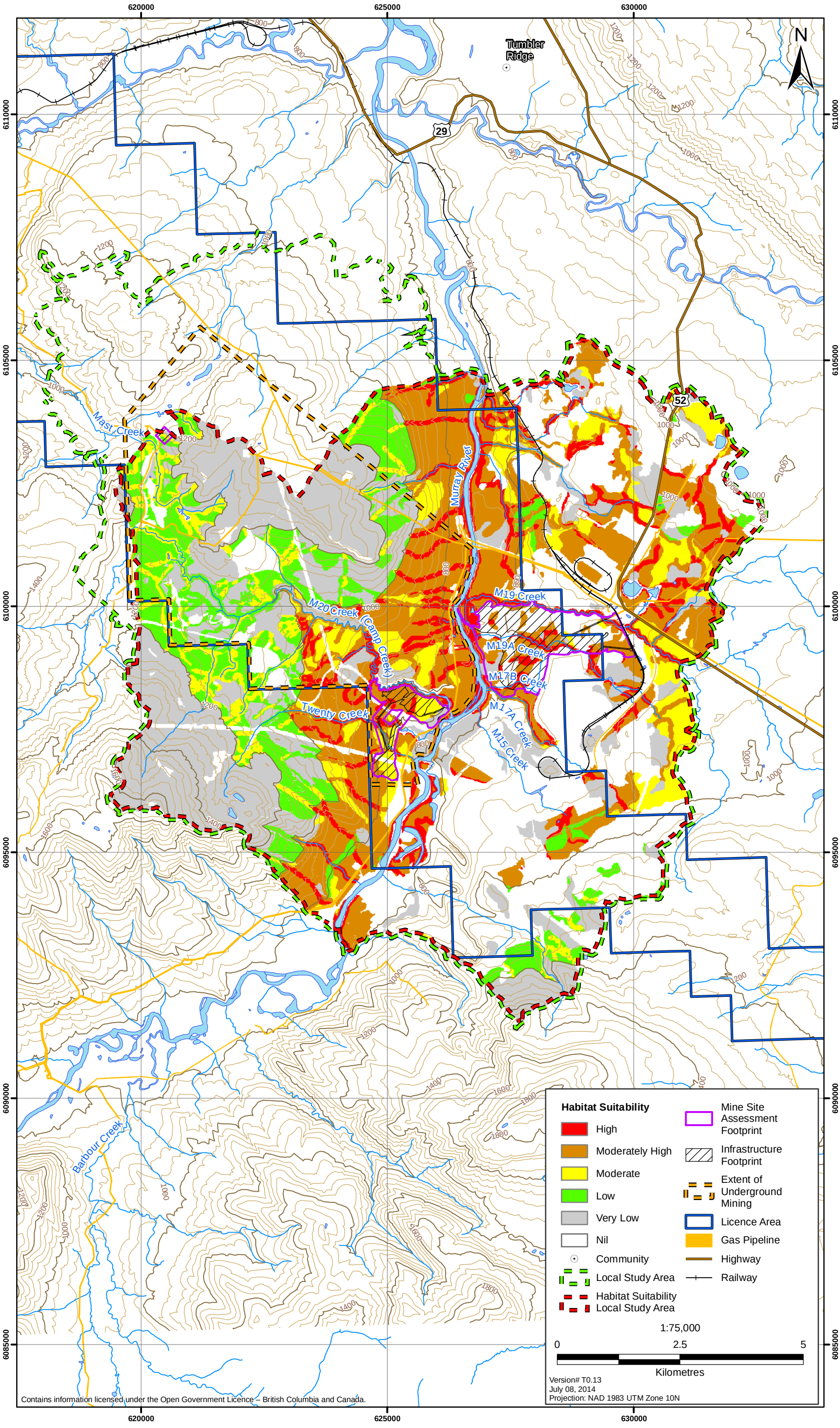
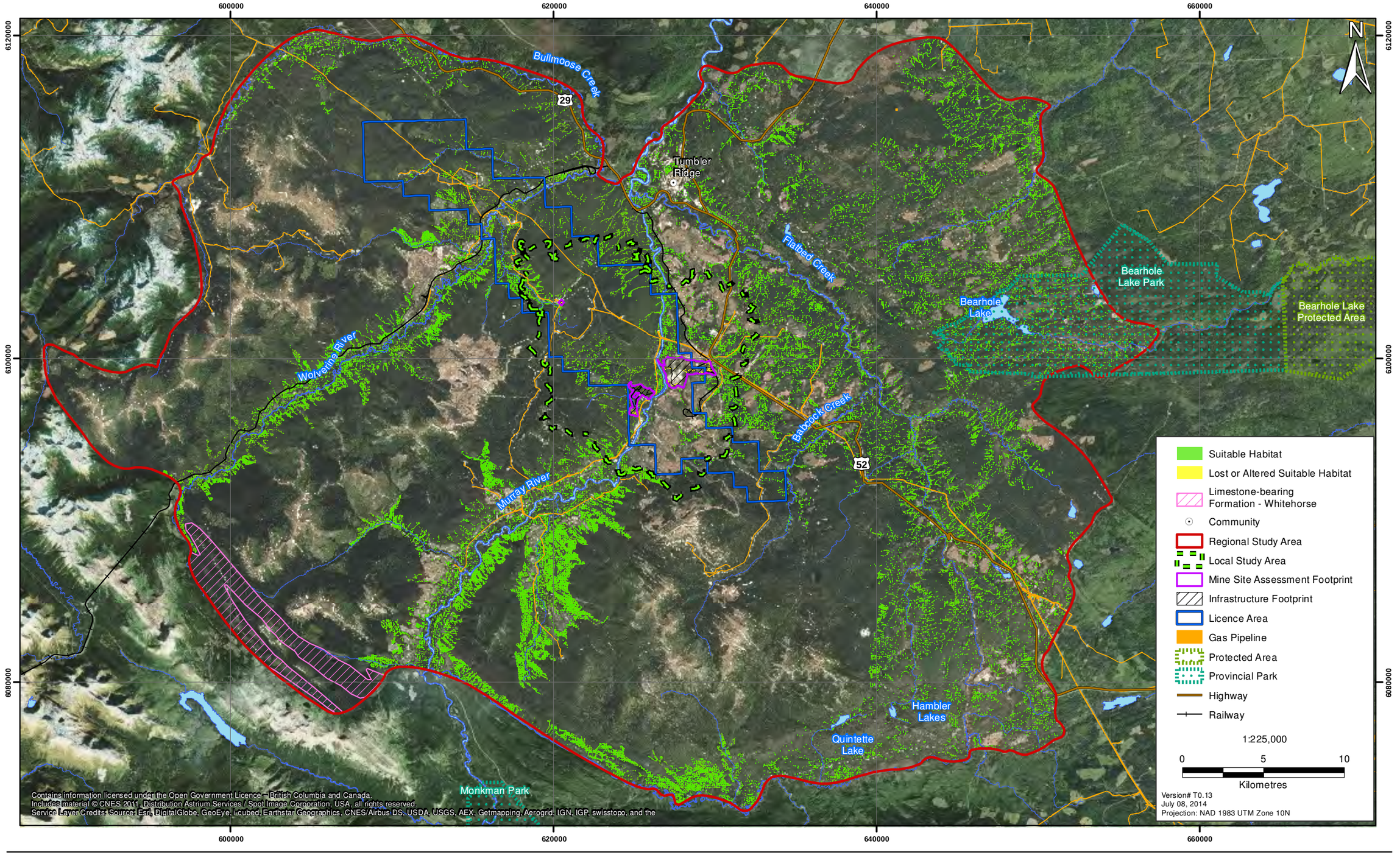


Figure 13.7-39
Bat: Suitable Habitat Lost due to the Mine Assesment Footprint in the Regional Study Area



Habitat Loss or Alteration due to Subsidence

After accounting for habitat lost due to the Mine Site Assessment Footprint, an additional 345 ha of suitable bat maternal roosting habitat (2.3% of total suitable habitat available in the RSA, and 10.1% of that available in the LSA) may be altered due to subsidence (Table 13.7-31). Figure 13.7-40 illustrates the total suitable bat maternal rooting habitat that may be altered within 200 m buffer zone of the coal seam panels where the effect of subsidence is anticipated to occur. The relative risk of change to suitable bat maternal roosting habitat is depicted by the number of overlapping panels to be mined, based on the Project Description (Section 3.6), where suitable bat maternal roosting habitat occurs (Table 13.7-31; Figure 13.7-40).

Table 13.7-31. Suitable Bat Maternal Roosting Habitat Potentially Altered due to Subsidence

Number of Panels Mined Vertically	Area of Suitable Habitat Potentially Altered (ha)	Regional Study Area		Local Study Area	
		Total Suitable Habitat [1] (ha)	Suitable Habitat Altered (%)	Total Suitable Habitat[1] (ha)	Suitable Habitat Altered (%)
1	23.1				
2	84.7				
3	112				
4	45.9				
5	0.0				
Total[1]	345	14,832	2.3	3,419	10.1

[1]*Total includes all suitable habitat that falls within the 200 m buffered subsidence area around panels, thus includes additional areas where no vertical panels are located.*

It is unclear how habitat quality for bat maternal roosting will change within the zone of subsidence, and not all suitable bat maternal roosting habitat within this area may be lost or altered. Thus, the assessment assumes a worst-case scenario whereby calculations are based only on suitable bat maternal roosting habitat that may be lost as a result of subsidence, but this is potentially an overestimate of actual habitat loss or alteration.

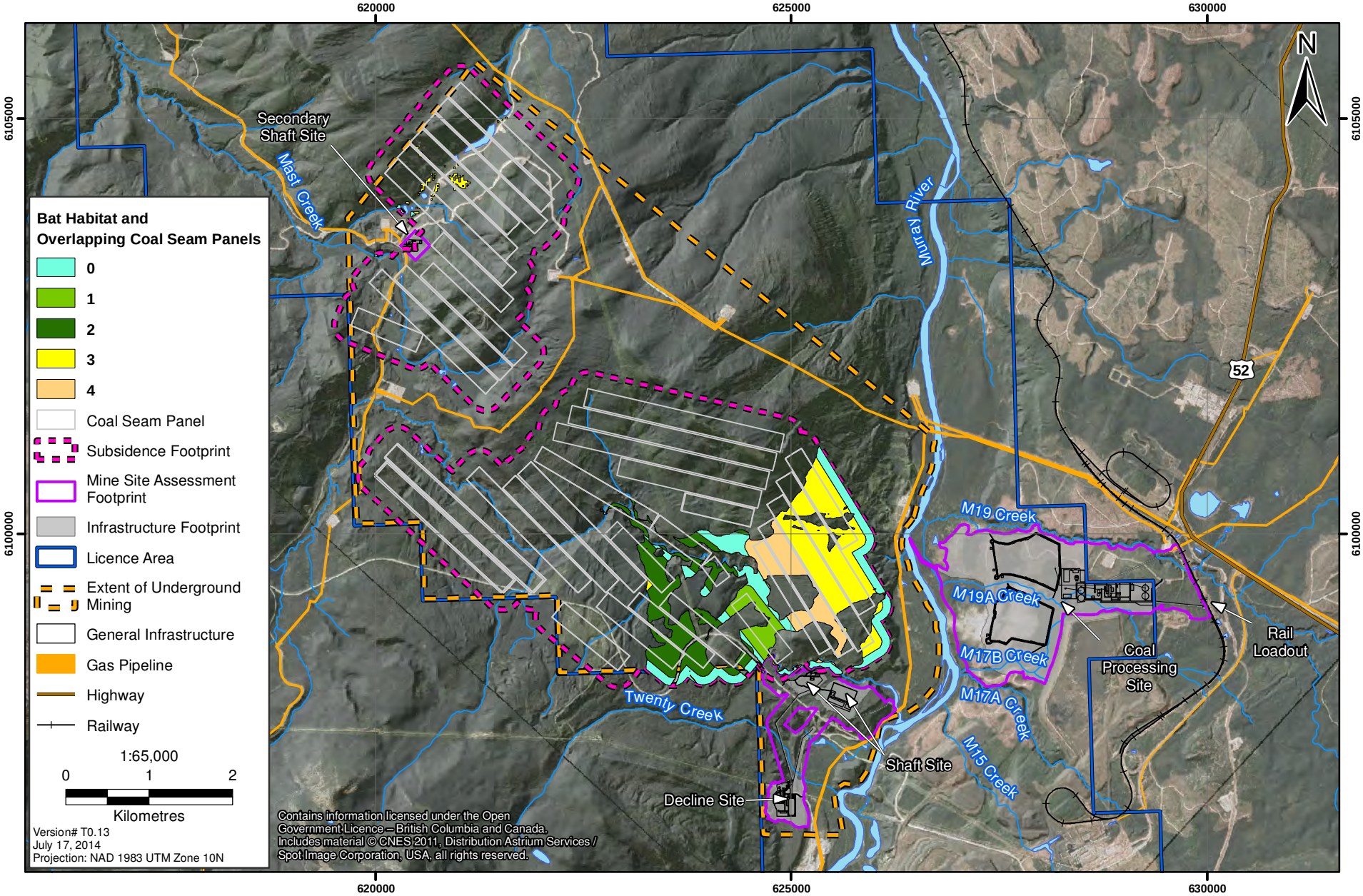
Residual Effect of Habitat Loss and Alteration for Bats

The effect of habitat loss and alteration is not predicted to result in a residual effect for bats. Habitat loss and alteration of suitable bat maternal roosting habitat will occur within the RSA and LSA as a result of the Mine Site Assessment Footprint; however, the loss is minimal (1.5% suitable habitat within the RSA). A total of 2.3% of the suitable habitat available in the RSA may potentially be altered due to subsidence; however this is assuming a worst case scenario where subsidence removes old trees and therefore bat habitat.

Additional mitigation measures to reduce the effect of habitat loss and alteration (Section 13.7.14.1 and detailed in Section 24.12, Wildlife Management Plan) would include avoiding sensitive roosting habitat such as large-diameter trees and suitable cave hibernacula sites where practical alternatives are available (e.g. habitat loss and alteration was minimized through Project design). Re-vegetation of some reclaimed components during Decommissioning and Reclamation will reduce the effects of habitat loss. After mitigation, the effect of habitat loss and alteration on bats is expected to be negligible; therefore, no residual effect of habitat loss and alteration on bats is predicted

Figure 13.7-40

Suitable Bat Maternal Roosting Habitat and Number of Overlapping Coal Seam Panels



13.7.13.2 Sensory Disturbance

This section evaluates the effects of sensory disturbance on bats. Potential sources of sensory disturbance for bats associated with the Project include elevated noise levels (i.e. Construction and Operation activities, vehicle and train traffic) and light sources.

Three types of noise effects were evaluated for potential effects on bats:

1. Project noise at the Mine Site Assessment Footprint = functionally lost
2. Vehicle noise along the access roads = degraded habitat
3. Train noise along the train route = low level disturbance

Bats rely on echolocation for detecting prey while foraging. Their frequency of hearing ranges between 20 – 110 kHz, depending on the species (Fenton and Bell 1981; D. W. Nagorsen and Brigham 1995; RIC 1998; O'Farrell, Miller, and Gannon 1999). For example, little brown myotis, a species of conservation concern, forage over open area such as water, forest trails, or meadows. In aquatic habitat their diet consists of aquatic insects and in terrestrial habitat their diet consists of a wide variety of insects such as moths and beetles (Kunz and Reichard 2012). Although the little brown myotis relies primarily on echolocation to find prey, the precautionary approach is taken for this assessment and it is assumed that noise may affect foraging.

Areas of high-quality bat maternal roosting habitat have the potential to be functionally lost if elevated noise levels prevent effective ecolocation. Studies have indicated that bats that find prey primarily by listening to prey sounds rather than echolocation can be disturbed up to approximately 50 m from noise disturbance from roads (Schaub, Ostwald, and Siemers 2008).

Noise disturbance was calculated by overlaying noise contours for continuous Project-related noise, and instantaneous vehicle traffic and train traffic noise with areas of suitable bat maternal roosting habitat (Section 13.6.3.2). Continuous Project noise was assessed using a 45 dBA Ln noise contour, while instantaneous traffic and train noise was assessed using the 75 dBA noise modelling contours.

Bat Habitat Functionally Lost or Disturbed due to Noise

Continuous Project Noise: Of the 14,832 ha of potential suitable maternal roosting habitat identified within the RSA, a total of 8.6 ha will be affected by Project noise during Construction after accounting for suitable maternal roosting habitat lost or altered within the Mine Site Assessment Footprints as a result of construction of the mine (Section 13.7.13.1). This is equivalent to 0.1% of the total potential suitable maternal roosting habitat within the RSA or 0.3% of the potential suitable maternal roosting habitat available within the LSA (Table 13.7-32; Figure 13.7-41). During Operation, the total amount of potential suitable maternal roosting habitat affected by Project noise is 50.1 ha. This is equivalent to 0.1% of the potential suitable maternal roosting habitat within the RSA and 0.4% within the LSA (Table 13.7-32; Figure 13.7-42).

Instantaneous Vehicle Traffic Noise: The total amount of suitable bat maternal roosting habitat that may be degraded by elevated traffic noise (75 dBA or greater), during Construction and Operation, after accounting for habitat lost or altered to clearing activities (Section 13.7.13.1), and

that functionally lost to continuous Project noise, is 14.9 ha (0.10% of the suitable habitat available in the RSA and 0.4% of that available in the LSA) during Construction and 13.7 during Operation (0.1% of suitable maternal roosting habitat in the RSA, and 0.3% of the suitable maternal roosting habitat in the LSA).

Table 13.7-32. Functional Loss of Suitable Bat Maternal Roosting Habitat due to Sensory Disturbance during Construction and Operation

		Regional Study Area			Local Study Area		
Type of Sensory Disturbance	Project Phase	Suitable Habitat Available (ha)	Suitable Habitat Functionally Lost (ha)	% Suitable Habitat Lost in RSA	Suitable Habitat Available (ha)	Suitable Habitat Functionally Lost (ha)[1]	% Suitable Habitat Lost in LSA
		14,832			3,419		
Continuous Project Noise (45 dBA)							
	Construction		8.6	0.06		8.6	0.3
	Operation		50.1	0.3		50.1	1.5
Instantaneous Traffic Noise(75 dBA)							
	Construction		14.9	0.1		12.8	0.4
	Operation		13.7	0.1		11.5	0.3
Instantaneous Train Noise (75 dBA)							
	Construction		-	-		-	-
	Operation		3,915	26.4		2,177	63.7

[1]*Area of Suitable Habitat Functionally Lost differs between the LSA and RSA as some of the area falls outside of the LSA but within the RSA.*

Instantaneous Train Noise: No Project-related trains are anticipated to run during Construction. The total amount of suitable bat maternal roosting habitat were elevated train noise will occur (75 dBA or greater) after accounting for suitable habitat lost due to habitat loss and alteration (Section 13.7.13.1), and that functionally lost to continuous Project noise and instantaneous traffic noise during Operation is 3,915 ha in the RSA (26.4% of the suitable habitat available in the RSA) and 2,177 ha in the LSA (0.4% of the suitable bat maternal roosting habitat in the LSA).

Light

Bats are nocturnal animals that are adapted to low-light conditions (Bat Conservation Trust 2008). Artificial lighting can increase chances of bat predation, and many species of bats, including Myotis tend to evade bright lights during foraging periods as a predator avoidance strategy (Bat Conservation Trust 2008). Bats can also be attracted to lights during foraging periods, due to the abundance of insect prey. The effect of attractants on bats is discussed in Section 13.7.13.4.

Figure 13.7-41

Bat: Functional Habitat Loss of Suitable Habitat due to Noise - Construction

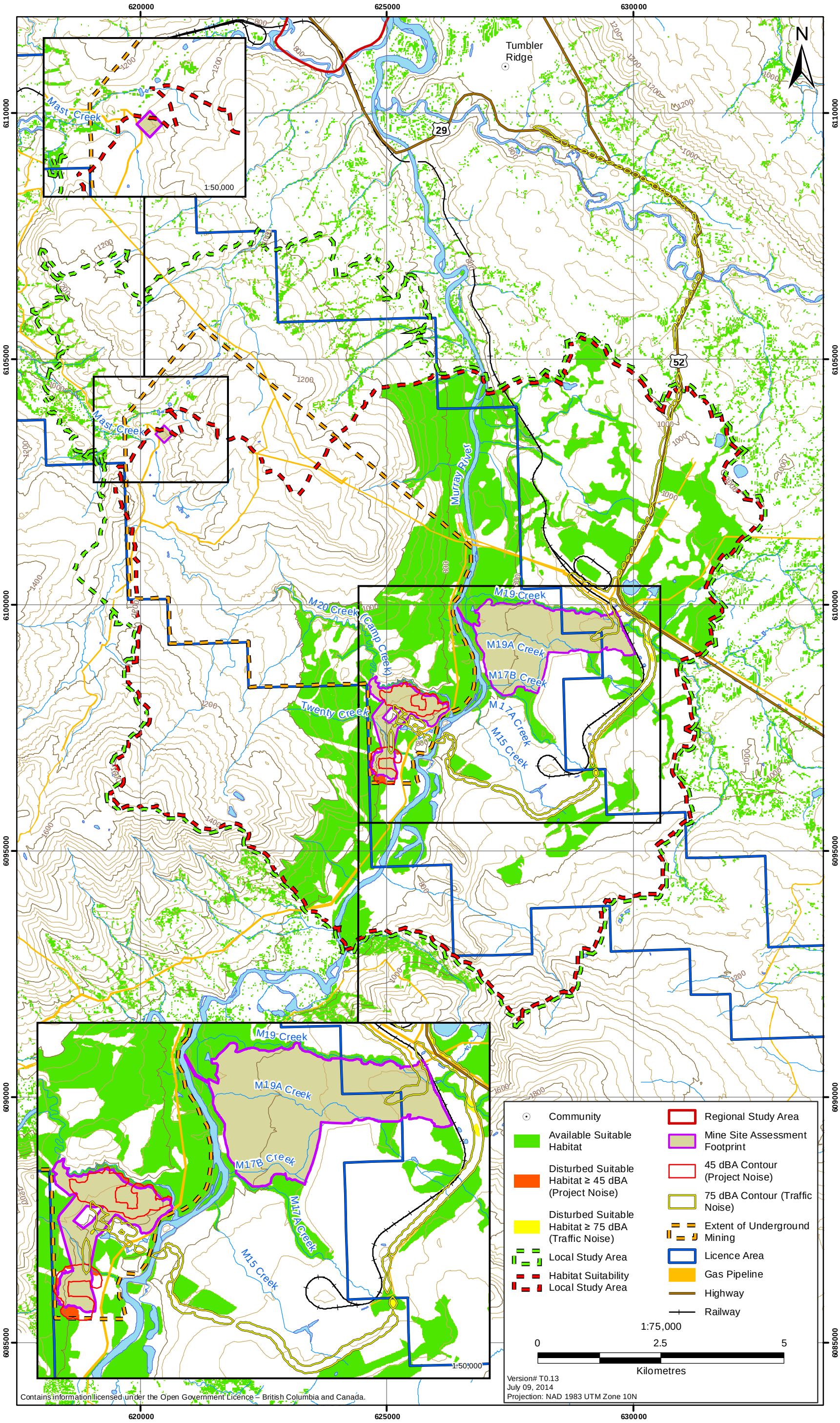
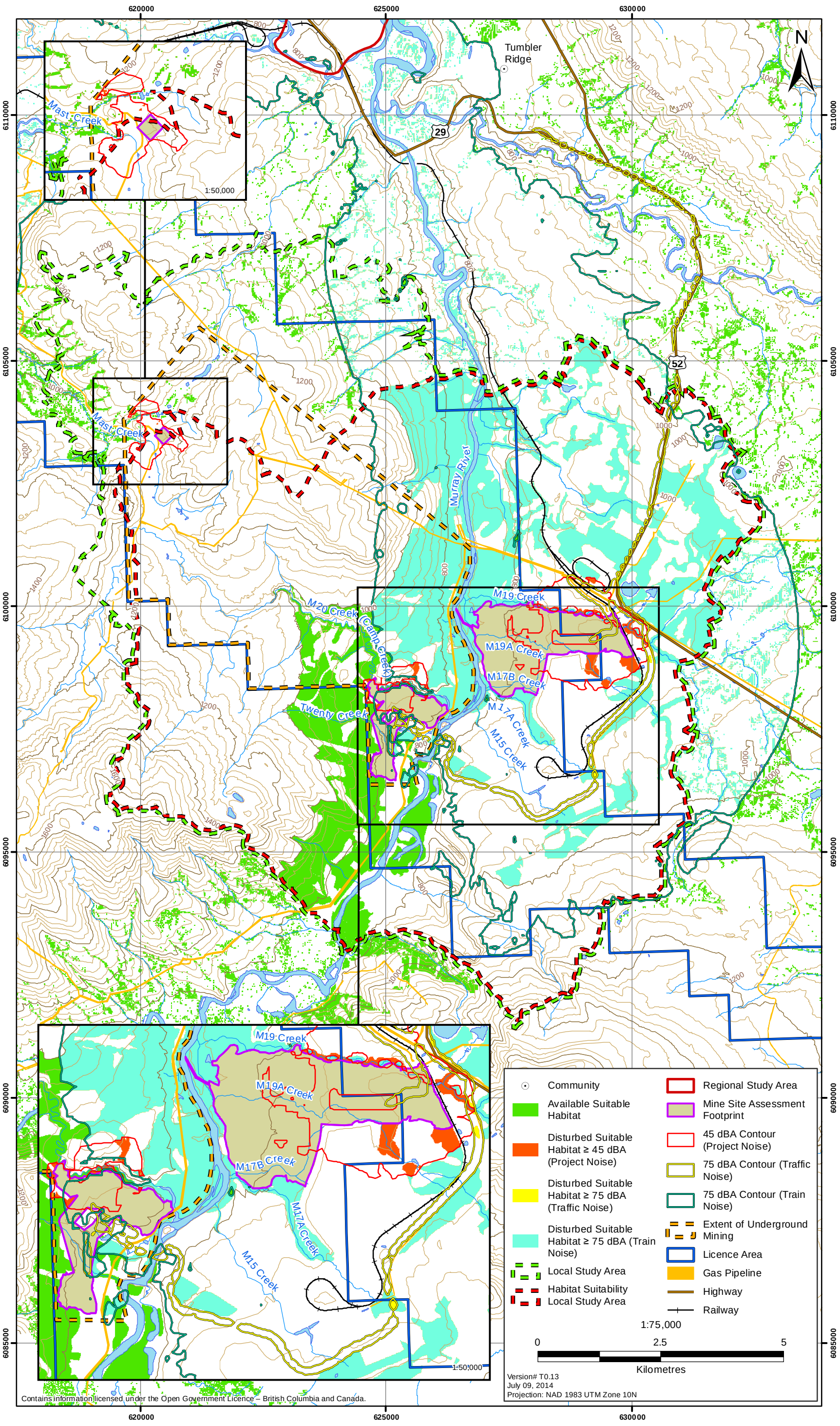


Figure 13.7-42

Bat: Functional Habitat Loss of Suitable Habitat due to Noise - Operation



Residual Effects of Sensory Disturbance for Bats

The effect of sensory disturbance due to noise is not predicted to result in a residual effect on bats. A small amount of suitable bat maternal roosting habitat within the RSA will be functionally lost or disturbed due to continuous Project noise during Construction and Operation (less than 1% of suitable habitat in the RSA) and instantaneous noise due to vehicle traffic (0.1% of suitable habitat in the RSA). While instantaneous noise due to train traffic is anticipated to result in disturbance to 26.4% of the suitable bat maternal roosting habitat within the RSA, this likely represents an overestimate of the habitat affected and will result in disturbance in these areas for only a brief period of time as a total of only 2 round trip Project trains (approximately 55 cars in length) will pass through. Thus the effects of noise disturbance due to trains is anticipated to be negligible. Mitigation strategies will be implemented to reduce the effects of sensory disturbance for bats (Section 13.7.14.2) as well as other wildlife (Section 24.12, Wildlife Management Plan). Noise levels will be monitored periodically at various wildlife receptor locations and mitigation strategies will be adjusted accordingly, if required (Section 24.3, Noise Management Plan). With mitigation, a residual effect of sensory disturbance on bats due to noise is not predicted.

The effect of sensory disturbance due to light is not predicted to result in a residual effect on bats. Bats within disturbed areas may avoid habitat due to noise and visual disturbance (i.e. light) as a predator avoidance tactic, which could reduce the foraging opportunities for bats. Mitigation measures will be implemented to reduce the effects of sensory disturbance for bats due to light (Section 13.7.14.4) such as minimizing illumination and appropriate light design. Due to the small area of disturbed habitat, no residual effect of sensory disturbance on bat due to light is predicted.

13.7.13.3 Direct Mortality

The potential sources of bat mortality in association with the Project may be mortality resulting from the destruction of maternal roost sites during Construction.

To minimize potential mortality from tree felling, pre-clearing surveys to identify and avoid bat roost sites will be conducted where possible within suitable habitat that could support maternal roost sites during the maternal roosting period (May 1 to September 31). If an active roost site is identified, the tree will not be felled and a suitable buffer zone will be maintained during the maternal roosting period, or BC MFLNRO (or the appropriate governing agency) will be contacted for guidance (Section 29.21, Wildlife Management and Monitoring Plan).

Residual Effects of Direct Mortality for Bats

The effect of direct mortality is not predicted to result in a residual effect on bats. Residual mortality effects in association with vegetation clearing are not expected for bats because a low percentage of suitable bat habitat overlaps areas that will be cleared and mitigation will prevent incidental destruction of roosts (Section 13.7.14.3). In addition, large roosts are unlikely to occur in the RSA due to the colder temperatures in northeastern BC (Kalcounis and Hecker 1995). Therefore, incidental destruction of bat roosts due to vegetation clearing would not likely affect a large number of bats. Pre-clearing surveys for active maternal roost sites will be conducted before clearing if development activities take place during the maternal roosting period (May to September). If an active roost site is

identified, the tree will not be felled and a suitable buffer zone will be maintained during the maternal roosting period, or BC MFLNRO (or the appropriate governing agency) will be contacted for guidance (Section 24.12, Wildlife Management Plan). With mitigation, no residual effect of direct mortality for bats is predicted.

13.7.13.4 Attractants

Inactive underground mine facilities have been found to support bat roosts and hibernacula (Tuttle and Taylor 1998). Other man-made structures, such as buildings and crevices in the rocks produced by excavation, may also be used as roosting sites by several species of bats, including the little brown myotis. Bats may be harmed if they roost in Project facilities and sites that were inactive but subsequently become re-activated.

Some bat species forage over water and on emergent aquatic insects (O'Shea, Clark, and Boyle 2000). Bats may be attracted to the aggregation of water brought to surface from underground during Construction and Operation and seepage water from the CCP during Operation, as these areas may become suitable habitat for insects. At least two species of myotis were detected within the RSA, one of which may be the little brown myotis (*M. lucifugus*). The little brown myotis is a species of conservation concern that forages regularly over water and on emergent aquatic insects (O'Shea, Clark, and Boyle 2000).

Bats can also be attracted to lights during foraging periods due to the abundance of insect prey. Studies suggest that many species of bats, including little brown myotis, forage at artificial lights (Geggie and Fenton 1985, Frurlonger et al. 1987).

Residual Effects of Attractants for Bats

The effect of attractants is not predicted to result in a residual adverse effect on bats. Project infrastructure within the Mine Site Assessment Footprint (e.g., lighted areas and underground facilities) will be monitored for bat activities and evidence of roosting during Construction and Operation to identify areas that may require potential mitigation or protection measures. Identified active bat roosts or hibernacula will be adaptively managed to discourage use and prevent future roosting (Section 24.12, Wildlife Management and Monitoring Plan). After mitigation, monitoring and adaptive management, no residual effects of attractants on bats are predicted.

13.7.14 Mitigation Measures for Bats

The Wildlife Management Plan (Section 24.12) describes the mitigation and management activities that are designed to reduce or eliminate potential effects to wildlife. Mitigation measures specific to bats are described in the following sections.

13.7.14.1 Mitigation for Habitat Loss and Alteration

The effects of habitat loss and alteration on all wildlife, including bats will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). Additional mitigation measures for habitat loss and alteration are detailed in the Decommissioning and Reclamation (Section 3.9). The potential effects of subsidence will be monitored as per the

Subsidence Management Plan (Section 24.15). Mitigation for direct habitat loss and alteration on bats will include, but is not limited to:

- avoidance of important habitat, such as forested habitats with large-diameter trees, and suitable cave hibernacula, where practical alternatives are available (e.g. habitat loss and alteration was minimized through Project design);
- no destruction or disruption of bat hibernacula or maternity roosts during site clearing during Construction and Operation of the Project; and
- re-vegetation of some reclaimed components during Decommissioning and Reclamation.

13.7.14.2 Mitigation for Sensory Disturbance

The effects of sensory disturbance on all wildlife are discussed in the Wildlife Management Plan (Section 24.12). The effects of sensory disturbance to bats will be minimized by mitigating the effects noise (Section 24.3, Noise Management Plan) and light. Guidelines will be followed to minimize the effects of noise on bats and other wildlife (Milko 1998a; BC MOE 2006a).

The following noise mitigation measures will be implemented for noise and are not limited to:

- noise specifications will be considered when selecting equipment to purchase;
- vehicles will be maintained regularly;
- speed limits will be imposed for on-site Project roads;
- mufflers will be installed on vehicles and maintained;
- noise dampening measures will be applied where possible; and
- noise will be monitored periodically at various human and wildlife receptor locations, as part of the Noise Management Plan (Section 24.3) and mitigation strategies will be adjusted accordingly, if required. Noise monitoring locations will be at locations to enable confirmation of noise modelling and effects assessment.

Mitigation measures for light are covered in Section 13.7.13.4 (Mitigation for Attractants).

13.7.14.3 Mitigation for Direct Mortality

The effects of direct mortality on all wildlife will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effect of direct mortality will largely be mitigated by the same mitigation measures for habitat loss (Section 13.7.12.1) and disruption of movement (Section 13.7.12.3).

Specifically, the effect of direct mortality to bats will be mitigated through the following measures:

- avoidance of vegetation clearing activities during sensitive periods for bats: bat maternal roosting periods (June 1 to August 31);
- where vegetation clearing cannot be conducted outside of sensitive periods, pre-clearing surveys will be conducted in areas of suitable habitat (i.e., areas of moist, mature and

old-growth forests within the ICHvc or CWHwm BEC zones, including large-diameter cottonwood, fir, and spruce along riparian areas) by a qualified biologist prior to vegetation clearing during these sensitive periods;

- if an active roost site is identified, the tree will not be felled and a suitable buffer zone will be maintained during the maternal roosting period, or BC MFLNRO (or the appropriate governing agency) will be contacted for guidance;
- if a cave-based bat hibernaculum are found during pre-clearing surveys, BC MFLNRO or the applicable provincial government agency will be notified and mitigation enacted, as directed;.
- yielding to speed limits along on-site Project roads and on Highways 52 and 29; and
- mortality events of bats will immediately be reported to the Environmental Monitor, and carcasses of unidentified bat species will be sent to the RBC Museum as voucher specimens when possible.

13.7.14.4 Mitigation for Attractants

The effects of attractants on all wildlife will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12).

The following mitigation measures will specifically reduce the effects of attractants to bats:

- monitoring and adaptive management of the use of physical structures (such as buildings and adits) by bats for security habitat (refuge, shelter), daily activities (roosting, perching), or nesting purposes;
- monitoring the quality and use of standing water in Project areas, and
- using low-pressure sodium lamps, fitting lamps with ultraviolet filters, or using directional lighting can reduce the effect on bats. Limiting times when lighting is used, particularly between April and September when bats are active, can also reduce the effects on bats (Fure 2006).
- lighting on infrastructure will be designed to minimize potential impact to wildlife including bats while ensuring safe operating conditions. The following mitigation measures for light are applied to reduce the sensory disturbance of light for bats:
- lighting will be strategically located, downward-directed lights to provide the lighting required to achieve safety standards while keeping “light pollution” to a minimum;
- the use of low-pressure sodium lamps, or fitting lamps with UV filters, whenever possible to reduce the effect on bats;
- directing all lighting into the facility and toward the ground to limit stray light as a visual disturbance;
- limiting times during which lighting is used, particularly between April and September when bats are active; and
- outdoor lighting will be designed for “dark sky” compliance whenever practical.

13.7.15 Key Effects on Raptors

Raptors were assessed for potential Project-related effects. Habitat loss and alteration, sensory disturbance, and direct mortality were considered for the effects assessment because those effects have the potential to create a residual effect on raptor populations. The effects of disruption of movement, indirect mortality, attractants and chemical hazards were scoped out of this assessment because they were determined to have no interaction with raptors.

Disruption of movement is not considered a potential effect for raptors because the Project will not have any towers or other structures which have been shown to impede raptor movement (Erickson, Johnson, and Young Jr 2005).

Indirect mortality due to increased roads, access, and hunting is not considered a potential effect for raptors because no new roads will be constructed for the Project that can provide access for hunters.

Attractants were not considered for raptors. In some areas, such as the Arctic, raptors can be attracted to mining pit walls for nesting. Nesting sites in the RSA are not limited and the Project will not have an open pit, so no attraction is assessed.

The potential effect of chemical hazards on raptors was scoped out of this assessment in Section 13.6.3.6. The major pathway of chemical uptake in raptors is from the ingestion of prey up the food web. Raptor prey such as small mammals and fish can achieve elevated concentrations of COPCs from the environmental media in which they live and forage. Uptake of COPCs was evaluated in several representative species of raptor prey including fish (Section 9). No residual effects were anticipated for uptake of COPCs in these prey species relative to baseline conditions. Thus, COPC uptake from prey up the food web through bioaccumulation processes was scoped out of the assessment for raptors.

The potential residual effects considered in the assessment for raptors during Construction, Operation, Decommissioning and Reclamation, and Post Closure phases are summarized in Table 13.7-33, and described in Sections 13.7.15.1 to 13.7.15. 4.

13.7.15.1 Habitat Loss and Alteration

The assessment evaluates the effects of habitat loss and alteration on raptors. Potential effects due to habitat loss may occur in areas where Project infrastructure overlaps suitable raptor nesting habitat. Ten species of raptors were recorded within the RSA during baseline studies for the Project (Appendix 13-A), and an additional ten species are known to occur in the RSA based on the results of other baseline studies (Section 13.5.4.9). All 20 of these species, except rough-legged hawk, are year round residents or seasonal breeders in the Peace Region; rough-legged hawk are seasonal migrants in the Peace Region.

All raptors are afforded legal protection in BC. Raptor nests and surrounding habitat are sensitive elements, which are protected under the *Wildlife Act* (1996b) and managed through provincial best management practices (BC MOE 2013b). Appropriate mitigation will be applied to ensure compliance with the *Wildlife Act* (1996b).

Table 13.7-33. Ranking Potential Effects on Raptors

Project Components/ Physical Activities	Potential Effects on Raptors					
	Habitat Loss and Alteration	Sensory Disturbance	Disruption of Movement	Direct Mortality	Attractants	Chemical Hazards
Construction						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	L	L	O	L	O	O
Shaft Site	O	L	O	O	O	O
Decline Site	O	L	O	O	O	O
Traffic and Transportation	O	L	O	L	O	O
Operation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	L	O	O	L	O	O
Traffic and Transportation	O	O	O	L	O	O
Decommissioning and Reclamation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	O	O	L	O	O
Post-Closure						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	O	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	O	O	L	O	O

(-) *No spatial or temporal overlap.*

O *Spatial and temporal overlap, but no interaction anticipated; no further consideration warranted.*

L *Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; no monitoring required, no further consideration warranted.*

M *Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*

H *Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

Raptor Nesting Habitat Requirements and Availability

Raptors have a variety of nesting preferences. Generally, most raptors require large, mature trees for nesting. For example, bald eagles and osprey build large stick platform nests at the tops of large, old trees, often within riparian corridors or near waterbodies. Other species nest in cavities, such as American kestrel and small owls; suitable cavities are most often present in mature forests and may be natural or those excavated by squirrels or woodpeckers. Northern harriers create nests on the ground in open grasslands, while peregrine falcons nest on steep, prominent cliffs, often near water.

Some forest-nesting raptors select a nest site in large, contiguous tracts of forest, while others nest along forest edges that are adjacent to open areas (e.g., meadows or wetlands) used for foraging. Most of the tree-nesting species that are expected to breed in the area exhibit the latter pattern; only northern goshawk and barred owl prefer to nest near the centre of large tracts of mature or old-growth forest.

To evaluate the potential effects of the proposed Project on raptor habitat, regional and local ecosystem mapping was used to identify potential high-quality nesting habitat for forest (tree) nesting raptors. Habitat loss and alteration was not considered for ground- and cliff-nesting raptors as the Project will not interact with the nesting habitat for northern harrier (grasslands), peregrine falcon (cliffs), or short-eared owl (meadow, alpine tundra).

High-quality forest nesting habitat for raptors was defined as mature and old-growth forests. These habitats were identified from two sources, Predictive Ecosystem Mapping (PEM) within the RSA and Terrestrial Ecosystem Mapping (TEM) within the LSA, and included structural stage 6 and 7 forests in all BEC zones. In addition, younger forests (structural stage 5) along riparian corridors in all BEC zones were also defined as high-quality habitat, in an effort to identify locations where old, large deciduous trees in floodplain forests may be available for nesting. A large amount of suitable forest nesting habitat exists within the RSA (112,311 ha) and the LSA (7,753 ha).

Raptor Nesting Habitat Loss and Alteration

Habitat Loss and Alteration due to the Mine Site Assessment Footprint

Of the 112,311 ha of available forest nesting habitat in the RSA, 210 ha (0.2% of the suitable nesting habitat in the RSA and 2.7% of the suitable nesting habitat in the LSA) would be lost or fragmented (i.e., Mine Site Assessment Footprint and fragmented area located in the Shaft and Decline Site) due to Project development (Table 13.7-34; Figure 13.7-43).

Table 13.7-34. Suitable Raptor Nesting Habitat Loss and Alteration due to the Project

Season	Suitable Habitat Lost and Altered (ha)	Regional Study Area		Local Study Area	
		Total Suitable Habitat (ha)	Suitable Habitat Lost/Altered (%)	Total Suitable Habitat (ha)	Suitable Habitat Lost/Altered (%)
Raptor Nesting Habitat	210	112,311	0.2	7,753	2.7

Habitat Loss or Alteration due to Subsidence

After accounting for habitat lost due to the Mine Site Assessment Footprint, an additional 1,263 ha of suitable raptor nesting habitat (9.7% of suitable nesting habitat available in the RSA, and 31.5% of that available in the LSA) may be potentially be altered due to subsidence (Table 13.7-35). Figure 13.7-44 illustrates the total suitable raptor nesting habitat that may be altered within 200 m buffer zone of the coal seam panels where the effect of subsidence is anticipated to occur. The relative risk of change to suitable raptor nesting habitat is depicted by the number of overlapping panels to be mined, based on the Project Description (Section 3.6), where suitable raptor nesting habitat occurs (Table 13.7-35; Figure 13.7-44).

Table 13.7-35. Suitable Raptor Nesting Habitat Potentially Altered due to Subsidence

		Regional Study Area		Local Study Area	
Number of Panels Mined Vertically	Area of Suitable Habitat Potentially Altered (ha)	Total Suitable Habitat [1] (ha)	Suitable Habitat Altered (%)	Total Suitable Habitat[1] (ha)	Suitable Habitat Altered (%)
Raptor Nesting Habitat					
1	191				
2	292				
3	455				
4	60.2				
5	60.9				
Total[1]	1,263	13,081	9.7	4,006	31.5

[1]*Total includes all suitable habitat that falls within the 200 m buffered subsidence area around panels, thus includes additional areas where no vertical panels are located.*

It is unclear how suitable raptor nesting habitat will change within the zone of subsidence, and not all suitable raptor nesting habitat within this area may be lost or altered. Thus, the assessment assumes a worst-case scenario whereby calculations are based on suitable raptor breeding habitat that may be lost as a result of subsidence, but this is potentially an overestimate of actual habitat loss or alteration.

Residual Effects of Habitat Loss and Alteration for Raptors

The effect of direct habitat loss and alteration is not predicted to result in a residual effect on raptors. The 210 ha of raptor nesting habitat in forests that will be affected accounts for 0.2% of the total amount of suitable nesting habitat available in the RSA and 2.7% of the total amount of suitable nesting habitat available in the LSA. An additional 1,263 could potentially be altered due to the effects of subsidence; however, this is likely an overestimate, since subsidence is unlikely to remove the forest. It should be noted that this is the area of available habitat, not the number of nests in the area. Mitigation will reduce the potential for negative effects on nests (Section 13.7.15.3; direct mortality).

Figure 13.7-43

Raptor: Habitat Lost due to the Mine Site Assessment Footprint

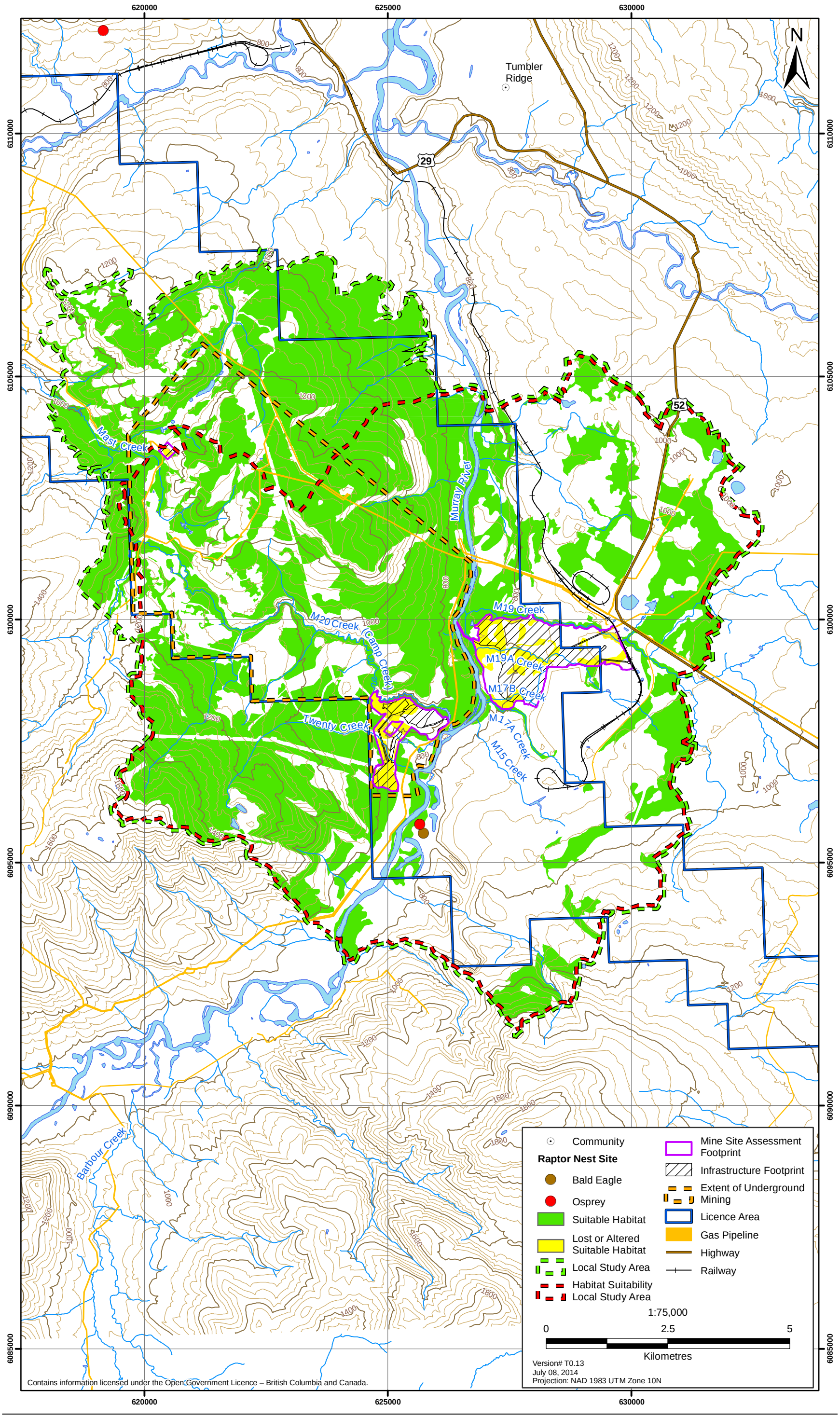
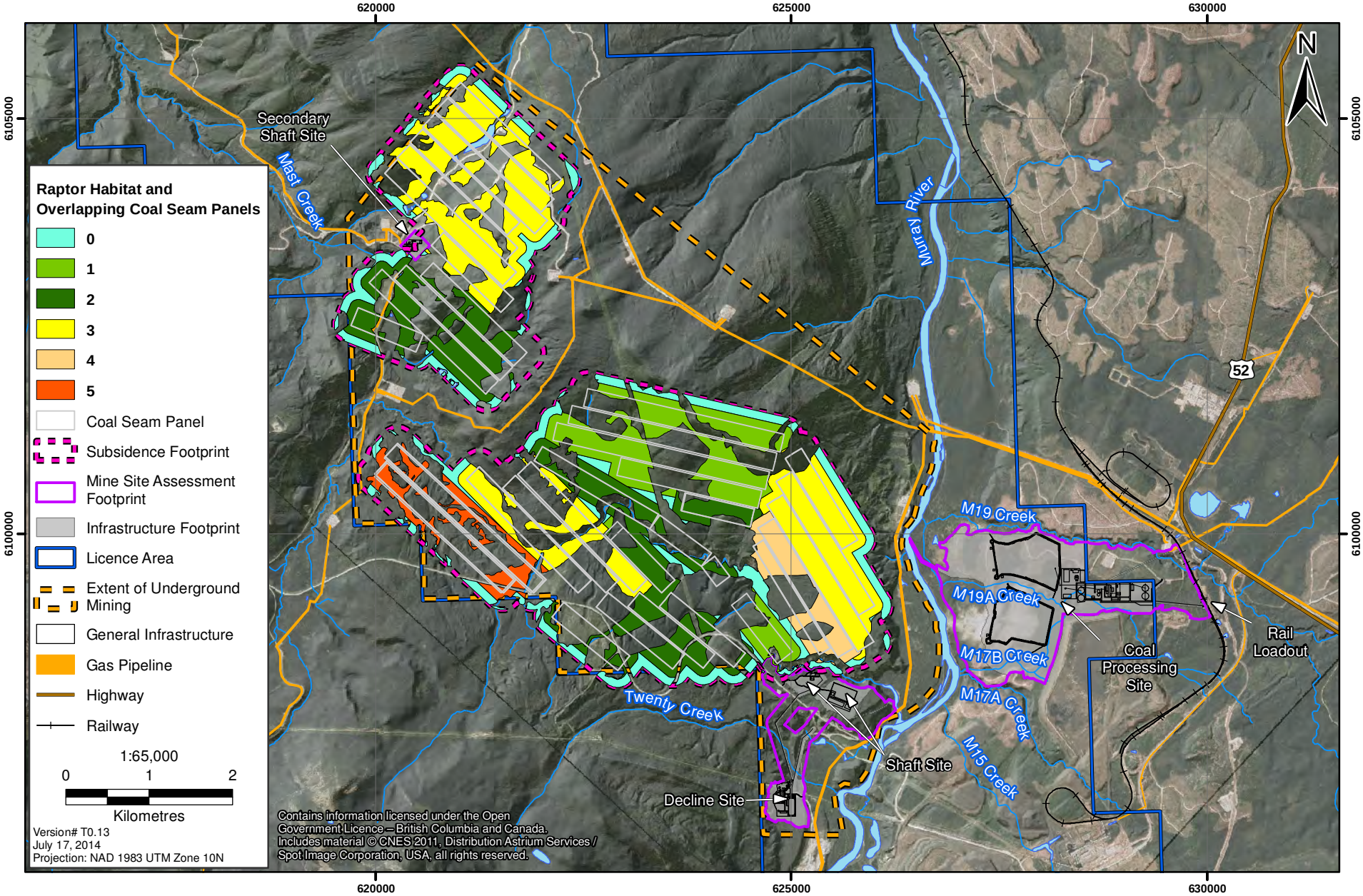


Figure 13.7-44

Suitable Raptor Habitat and Number of Overlapping Coal Seam Panels



At Decommissioning and Reclamation, and Post Closure habitat will be restored to comparable value to that lost during Project development and Operation. The succession of reclaimed habitat to high-value old forest habitat will take many years and will only be targeted at areas that were previously forested. However since nests will be protected, after consideration of mitigation measures, and reclamation activities, no residual effect of habitat loss is anticipated for raptors.

13.7.15.2 Sensory Disturbance

Potential sources of sensory disturbance for raptors associated with the Project include elevated Project noise levels and human presence. Elevated noise is a concern for raptor species that use sound for prey location such as owls. Noise from vehicle and train traffic was not assessed. Research has shown that some raptor species appear able to habituate to instantaneous disturbances such as traffic noise. Infrequent noises from heavy truck traffic (logging trucks) were reported to have no discernible effect on breeding raptors (Grubb, Pater, and Delaney 1998). In addition, raptors (e.g. peregrine falcon), seem to be able to habituate to noise disturbances from rail traffic as nest sites have been located under train trestles (EC 2007).

Effects of Noise on Raptors

Studies have reported that raptors are affected by disturbances as varied as pedestrian foot traffic to military training procedures (D. E. Andersen, Rongstad, and Mytton 1990; Richardson and Miller 1997; Schueck, Marzluff, and Steenhoff 2001). Behavioural responses can be as straight forward as nest abandonment or decreased egg incubation leading to mortality of embryos or nestlings, to more subtle effects such as home range shifts and decreased energy intakes due to changes to foraging behaviour (White and Thurow 1985; D. E. Andersen, Rongstad, and Mytton 1990; Richardson and Miller 1997). Spatial and temporal buffer distances have been recommended surrounding nest sites in order to minimize disturbance effects (Richardson and Miller 1997; SKCDC 2003; BC MWLAP 2004b).

Disturbance to raptor nesting habitat due to noise was calculated by overlaying noise contours for continuous Project-related noise with areas of suitable raptor habitat (Section 13.6.3.2). A GIS analysis was conducted to determine the amount of suitable raptor nesting habitat that could be functionally lost or disturbed due to continuous Project noise from Project-related activities. Continuous Project noise was assessed using a 45 dBA Ln noise contour. The area of suitable raptor nesting habitat that fell within the 45 dBA noise modelling contours was calculated. The area of overlap with suitable raptor nesting habitat lost or altered due to Project infrastructure was not included in these calculations, as they were considered in Section 13.7.15.1.

Raptor Habitat Functionally Lost or Disturbed due to Noise

The total area of suitable raptor nesting habitat within the RSA that may be disturbed due to continuous Project noise is 12.1 ha (0.01% of the suitable raptor nesting habitat in the RSA, 0.2% of the suitable raptor nesting habitat in the LSA) during Construction (Table 13.7-36; Figure 13.7-45) and 91.6 ha (0.1% of the suitable raptor nesting habitat in the RSA, 1.2% of the suitable raptor nesting habitat in the LSA) during Operation (Table 13.7-36; Figure 13.7-46). The majority of suitable raptor nesting habitat that will be disturbed due to Project noise during Construction will occur south of the Shaft and Decline Site (Shaft and Decline Site; Figure 13.7-45) and during Operation will occur north of the Shaft and Decline Site and north and south of the Coal Processing Plant (Coal Processing Site) on the eastern side (Figure 13.7-46).

Figure 13.7-45

Raptor: Functional Habitat Loss of Suitable Habitat due to Noise - Construction

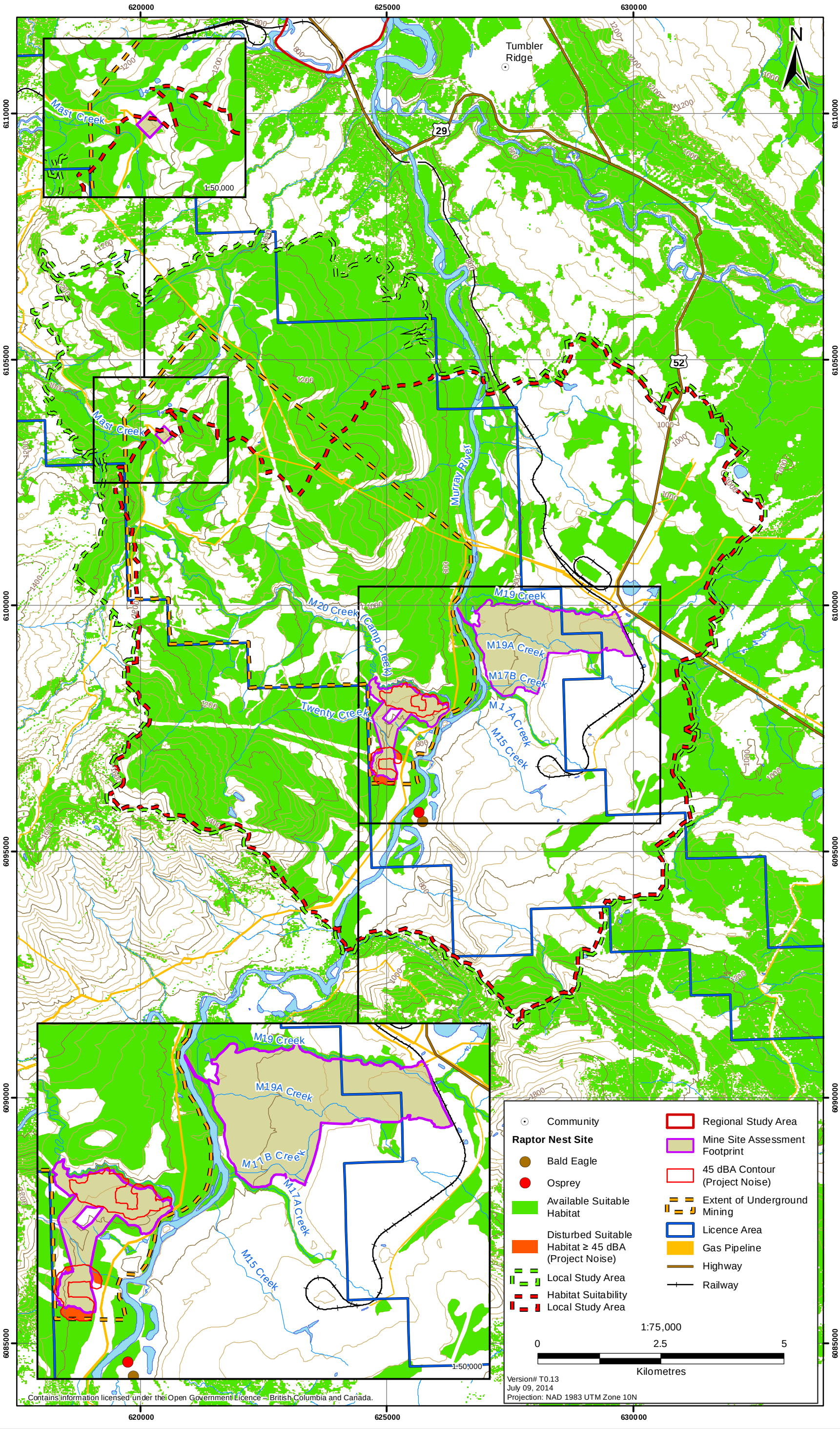


Figure 13.7-46

Raptor: Functional Habitat Loss of Suitable Habitat due to Noise - Operation

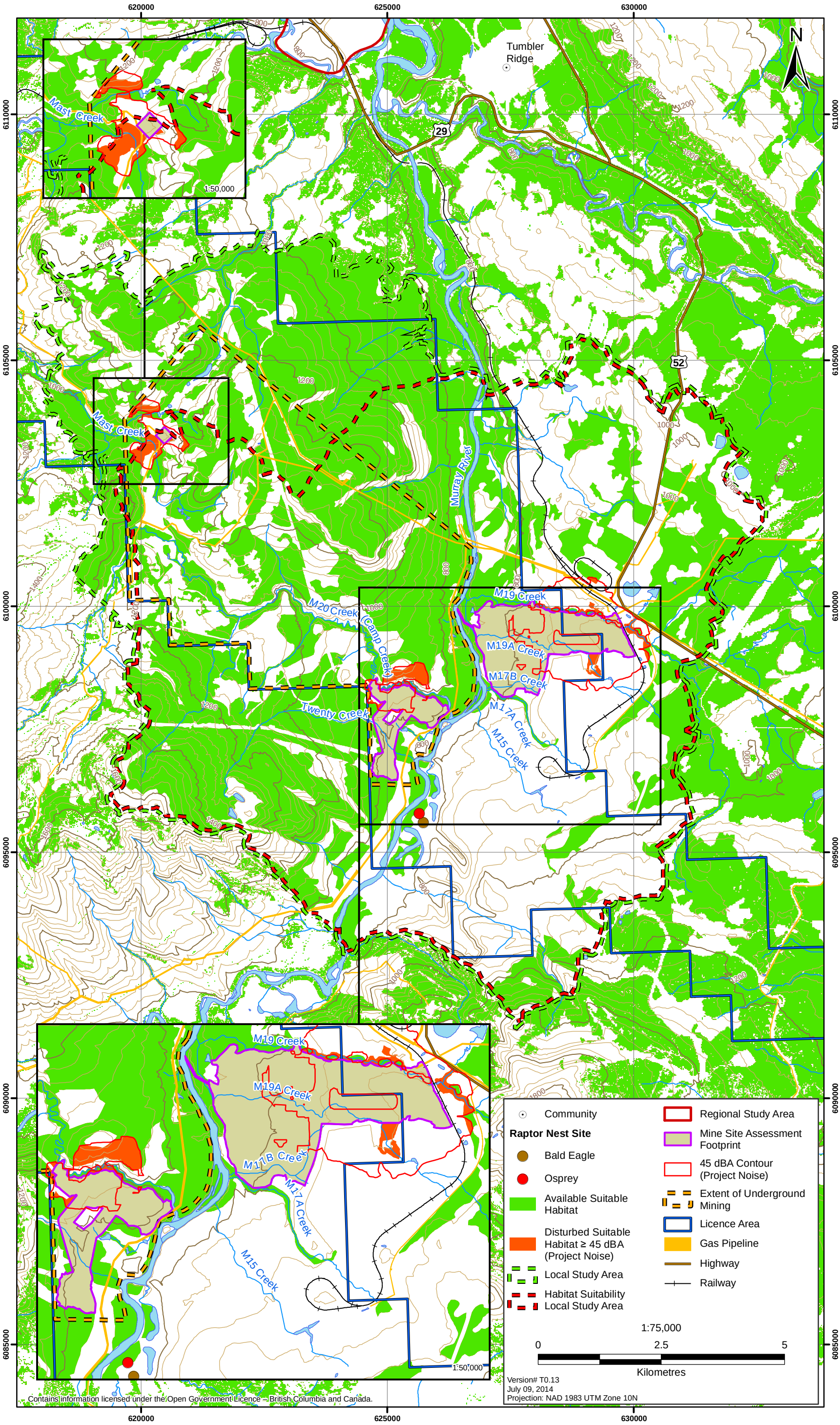


Table 13.7-36. Functional Loss of Suitable Raptor Habitat due to Sensory Disturbance during Construction and Operation

Type of Sensory Disturbance	Project Phase	Regional Study Area			Local Study Area		
		Suitable Habitat Available (ha)	Suitable Habitat Functionally Lost[1] (ha)	% Suitable Habitat Lost in RSA	Suitable Habitat Available (ha)	Suitable Habitat Functionally Lost[1] (ha)	% Suitable Habitat Lost in LSA
		112,311			7,753		
Continuous Project Noise (45 dBA)							
	Construction		12.1	0.01		12.1	0.2
	Operation		91.6	0.1		91.6	1.2

[1]*Incudes high-quality habitat functionally lost after accounting for habitat loss (Section 13.7.15.1)*

Residual Effects of Sensory Disturbance for Raptors

Sensory disturbance is not predicted to result in residual effects on raptors. A total of 0.01% and 0.1% of the suitable habitat for forest nesting raptors within the RSA will be functionally lost due to sensory disturbance from the Construction and Operation phases, respectively.

Mitigation measures will include clearing surveys and identification of potential nesting habitats, and the application of appropriate buffers around nests, if observed. With mitigation, no residual effects for raptors due to sensory disturbance during the Construction or Operation phases are predicted.

13.7.15.3 Direct Mortality

Potential Project-related sources of mortality and injury of raptors can result from destruction of nests during vegetation clearing and from vehicle collisions.

Construction activities could result in direct mortality of raptors through clearing of vegetation actively used for nesting. Clearing activities for the development of Project infrastructure are anticipated to occur within the Mine Site Assessment Footprints. The habitat selected by raptors is described in Section 13.7.15.1, as well as a quantitative analysis of the amount that will be cleared during Construction and Operation. There is some suitable raptor nesting habitat that is anticipated to be lost as a result of development of the Mine Site Assessment Footprints (Section 13.7.15.1; Figure 13.7-43;). Thus, there is some potential for destruction or abandonment of raptor nests from clearing activities within these areas. The *Wildlife Act* (1996b) specifically protects birds, their nests, and their eggs from possession, molestation, or destruction. Mitigation measures will be in place to reduce the effects of direct mortality due to vegetation clearing on raptors (Section 13.7.16.3).

Residual Effects of Direct Mortality for Raptors

Direct mortality is not expected to result in a residual effect for raptors. If Project development activities take will take place during the breeding season (March 1 to August 15), pre-clearing surveys for active nests would be conducted prior to clearing, (Section 13.7.16.3). With mitigation, a residual effect of direct mortality due to vegetation clearing is not predicted. Thus, overall, a residual effect of direct mortality is not predicted for raptors.

13.7.16 Mitigation Measures for Raptors

The Wildlife Management Plan (Section 24.12) describe the mitigation and management activities that are designed to reduce or eliminate potential effects to wildlife. Mitigation measures specific to raptors are described in the following sections.

13.7.16.1 Mitigation for Habitat Loss and Alteration

The effects of habitat loss and alteration on all wildlife, including raptors will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). Additional mitigation measures for habitat loss and alteration are detailed in Decommissioning and Reclamation (Section 3.9). The potential effects of subsidence will be monitored as per the Subsidence Management Plan (Section 24.15). Mitigation for direct habitat loss and alteration on raptors will include, but is not limited to:

- avoidance of important habitat, such as forested habitats, cliff bands, and ledges, where practical alternatives are available (e.g. habitat loss and alteration was minimized through Project design);
- no destruction or disruption of active raptor nests during Construction and Operation. Inactive raptor nests or nests found outside of the breeding season will also be maintained or relocated, in consultation with appropriate regulators (BC Wildlife Act, 1996b; BC MOE 2013b); and
- re-vegetation of some reclaimed components during Decommissioning and Reclamation.

13.7.16.2 Mitigation for Sensory Disturbance

The effects of sensory disturbance on all wildlife are discussed in the Wildlife Management Plan (Section 24.12). The effects of sensory disturbance to raptors will be minimized by mitigating the effects noise (Section 24.3, Noise Management Plan). Guidelines will be followed to minimize the effects of noise on raptors and other wildlife (Milko 1998; BC MOE 2013b).

The following noise mitigation measures will be implemented and are not limited to:

- noise specifications will be considered when selecting equipment to purchase;
- vehicles will be maintained regularly;
- speed limits will be imposed for on-site Project roads;
- mufflers will be installed on vehicles and maintained;
- noise dampening measures will be applied where possible; and
- noise will be monitored periodically at various human and wildlife receptor locations, as part of the Noise Management Plan (Section 24.3) and mitigation strategies will be adjusted accordingly, if required. Noise monitoring locations will be at locations to enable confirmation of noise modelling and effects assessment.

13.7.16.3 Mitigation for Direct Mortality

The effects of direct mortality on all wildlife will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effect of direct mortality will largely be mitigated by the same mitigation measures for habitat loss (Section 13.7.12.1).

Specifically, the effect of direct mortality to raptors will be mitigated through the following measures:

- scheduling vegetation clearing activities outside of sensitive periods (e.g., nesting/fledging from March 1 to August 15 for raptors), where feasible; and
- when clearing cannot be scheduled outside the raptor sensitive period, a qualified on-site monitor will conduct a reconnaissance survey prior to clearing to identify active and inactive raptor nests in trees. If an active nest is found (occupied by a bird or an egg), the nest tree is protected from destruction under Sections 34(b) and 34(c) of the BC *Wildlife Act* (1996). Forested and "quiet area" buffers will also be established around the nest site to limit disturbance as recommended by the BC MOE (Section 24.12, Wildlife Management Plan).

13.7.16.4 Mitigation for Attractants

The effects of attractants on all wildlife will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effect of attractants on raptors will also be mitigated by adhering to the Waste Management Plan (Section 24.13), which will include mitigation measures to store and remove all food wastes and wildlife attractants (e.g., liquid solvents, lubricants).

The following mitigation measures will specifically reduce the effects of attractants to raptors:

- monitoring and adaptive management of the use of physical structures by wildlife for security habitat (refuge, shelter), daily activities (roosting, perching), or nesting purposes;
- if raptor nests are observed on Project infrastructure, the Environmental Monitor will be notified immediately and he/she will contact the appropriate regulatory agency for advice;
- all waste will be stored inside buildings, or in wildlife-proof containers;
- waste disposal facilities will be monitored for signs of wildlife presence (i.e., wildlife mediated waste dispersion, etc.); and
- when monitoring identifies situations where wildlife are accessing waste, and waste disposal practices are not in compliance with permit requirements, a management response will be triggered. The response will assess the situation and determine the cause of the problem. Adaptive management will be developed on a case-by-case basis when waste misdirection is identified.

13.7.17 Key Effects on Songbirds

Migratory songbirds were assessed for potential Project-related effects. Black-throated green warbler was chosen as a representative songbird species for the effects assessment as they are provincially blue-listed in BC and the Dawson Creek LRMP has an objective of managing critical habitat for red and blue-listed migratory songbird species within the Murray River subzone (BC ILMB 1999). The Canada warbler shares similar nesting habitat of mixed forests and mesic areas (Reitsma et al. 2010) to the black-throated green warbler and so if captured by this assessment. The other species of conservation concern that were observed or probably within the RSA, olive-sided flycatcher and rusty blackbird share similar to habitat to other VCs that were assessed. Rusty blackbirds nest near the edges of wetland (Avery 1995) and are therefore considered to be captured by the waterbirds assessment. Olive-sided flycatchers use snags often at the edge of forested habitats (Altman and Sallabanks 2000) and would share habitat similarities to raptors and are therefore considered captured by that assessment. Habitat loss and alteration, sensory disturbance, and direct mortality were considered for songbirds in the effects assessment because those effects have the potential to create a residual effect on songbirds. The effects of disruption of movement, indirect mortality, attractants, and chemical hazards were scoped out of this assessment because they were determined to have no interaction with songbirds.

Disruption of movement is not considered a potential effect for songbirds as these species can avoid infrastructure by flying around or over obstacles. Indirect mortality is not considered a potential effect for migratory songbirds because the primary source of indirect mortality identified for wildlife VCs in association with Project development is increased harvesting pressure, and songbirds are not hunted or trapped. Attractants are not considered as a potential effect for songbirds because songbirds are not typically attracted to industrial developments except for a few individuals that may attempt to nest on buildings.

The potential effect of chemical hazards on songbirds was scoped out of this assessment in Section 13.6.3.6. The major pathway of chemical uptake in songbirds is from the ingestion of soil, vegetation, water, and prey up the food web (e.g. insects). Since predicted concentrations in soil had HQs below 1.0 thus COPCs in soil were screened out of the assessment (Section 18.8.3.1). No vegetation specific guidelines for COPCs are available, however, the soil quality guidelines are considered to be protective against effects to vegetation or higher trophic level consumers. Since predicted soil concentrations are anticipated to be below an HQ of 1.0, uptake of COPCs from vegetation were also screened out of the assessment. While M19A Creek and the wetland habitat between the Coal Processing Site and the Murray River are anticipated to exceed water quality guidelines (for the protection of wildlife) for selenium, most songbirds are anticipated to receive the majority of their water requirement through the ingestion of vegetation and prey. Thus, COPC uptake from water was scoped out of the assessment for songbirds. However, some songbirds may ingest prey and water from wetlands. Songbirds, such as red-winged black bird that use wetlands for foraging and breeding, are considered under the assessment of the effects of chemical hazards to waterbirds (Section 13.7.19.5).

The potential residual effects considered in the assessment for songbirds during Construction, Operation, Decommissioning and Reclamation, and Post Closure phases are summarized in Table 13.7-37, and described in the following sections, from Section 13.7.17.1 to 13.7.17.4.

Table 13.7-37. Ranking Potential Effects on Songbirds

Project Components/ Physical Activities	Potential Effects on Songbirds					
	Habitat Loss and Alteration	Sensory Disturbance	Disruption of Movement	Direct and Indirect Mortality	Attractants	Chemical Hazards
Construction						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	L	L	O	L	O	O
Shaft Site	O	L	O	O	O	O
Decline Site	O	L	O	O	O	O
Traffic and Transportation	O	L	O	L	O	O
Operation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	L	O	O	L	O	O
Traffic and Transportation	O	L	O	L	O	O
Decommissioning and Reclamation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	L	O	L	O	O
Post-Closure						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	O	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	L	O	L	O	O

(-) *No spatial or temporal overlap.*

O *Spatial and temporal overlap, but no interaction anticipated; no further consideration warranted.*

L *Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; no monitoring required, no further consideration warranted.*

M *Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*

H *Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

13.7.17.1 Habitat Loss and Alteration

A total of 72 songbird species were identified during the 2010 baseline studies (Section 13.5.3; Appendix 13-A). These species occupy a diverse array of habitats, including coniferous forest, deciduous forest, mixed forest, wetlands, and anthropogenic habitats. Twenty-three species were found in only one habitat. However, no significant differences were found in species diversity and equitability among habitat types.

Three species of conservation concern were observed during baseline surveys: barn swallow, black-throated green warbler, and olive-sided flycatcher. All three are provincially blue-listed (Special Concern). In addition, the barn swallow has been listed as Threatened by COSEWIC and the olive-sided flycatcher is listed on Schedule 1 of SARA as Threatened. Five other species of conservation concern were detected during roadside surveys in previous years (Westcam 2008) and possibly breed in the Murray River area; bay-breasted warbler, Canada warbler, Cape May warbler, Connecticut warbler, and rusty blackbird. As active nests and eggs of songbirds are protected under the *Wildlife Act* (1996b) and *Migratory Birds Convention Act* (1994a), effects of habitat loss and alteration are considered for this group as represented by the black-throated green warbler, and mitigation is required to prevent the removal of active nests during Construction.

Songbird Habitat Requirements and Availability

Overall, during baseline studies, songbirds occupied a variety of habitats and BEC zones within the LSA and RSA at similar densities (Section 13.5.3.2). To evaluate the potential effects of the proposed Project on suitable songbird nesting habitat, regional and local habitat suitability modelling was used to identify potential high-quality nesting habitat for songbirds (Section 13.5.3.2). The black-throated green warbler was used as a representative species for habitat suitability modelling. Results of habitat suitability modelling indicated that just under a third (4,006 ha) of the LSA consisted of high-quality breeding habitat for the black-throated green warbler and 13,081 ha exists within the RSA. Suitable breeding habitat for black-throated green warbler occurs within both the Mine Site Assessment Footprints and within the extent of underground mining, primarily on the south eastern sides.

Direct habitat loss and alteration (i.e., due to the Mine Site Assessment Footprints) would occur wherever forest stands are cleared. Most songbirds are sensitive to habitat features such as vegetation composition and vertical stratification, snags, and the age of trees within a stand (Harrison, Schmiegelow, and Naidoo 2005). In addition to direct removal of forest stands, removal of snags and other debris from otherwise open areas can constitute habitat loss for species that rely on these features.

Habitat Loss and Alteration due to the Mine Site Assessment Footprint

Overall, at the end of the Operation phase, a total of 237 ha (1.8% of the high-quality black-throated green warbler breeding habitat in the RSA, 5.9% of the high-quality breeding habitat in the LSA) will be removed or altered (Table 13.7-38). The majority of this loss and alteration will occur in the northern portion of the Shaft and Decline Site Mine Site Assessment Footprint (western Assessment Footprint) with smaller amounts in the Coal Processing Site Mine Assessment Footprint (eastern Assessment Footprint; Figure 13.7-47).

Figure 13.7-47

Black-throated Green Warbler: Breeding Habitat Lost due to the Mine Site Assessment Footprint

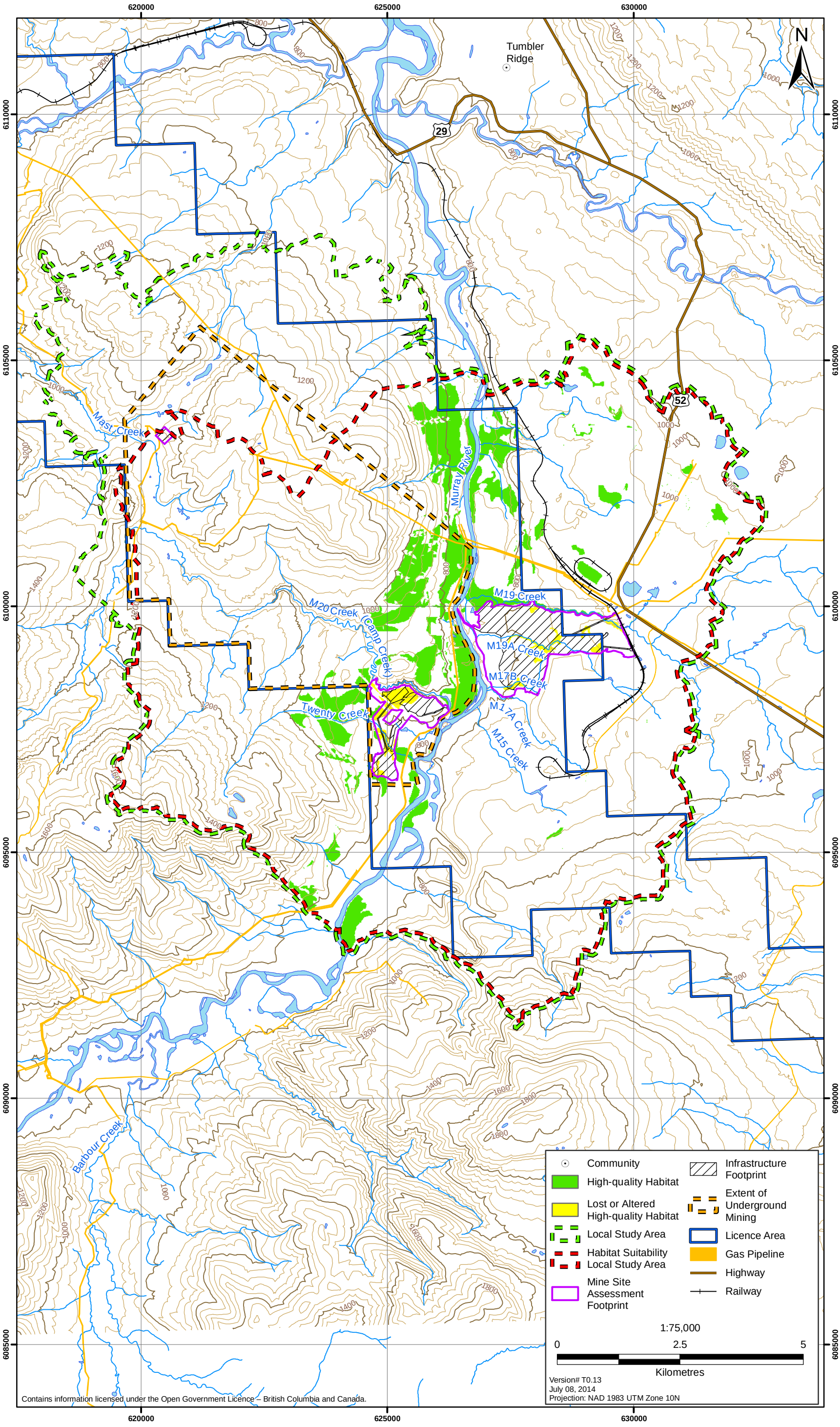


Table 13.7-38. High-quality Black-throated Green Warbler Breeding Habitat Loss and Alteration due to the Project Mine Site Assessment Footprint

Season	High-quality Habitat Lost and Altered (ha)	Regional Study Area		Local Study Area	
		Total High-quality Habitat (ha)	High-quality Habitat Lost/Altered (%)	Total High-quality Habitat (ha)	High-quality Habitat Lost/Altered (%)
Black-throated Green Warbler Breeding Habitat	237	13,081	1.8	4,006	5.9

Habitat Loss or Alteration due to Subsidence

After accounting for habitat lost due to the Mine Site Assessment Footprint, an additional 539 ha of high-quality black-throated green warbler breeding habitat (4.1% of total high-quality habitat available in the RSA, and 13.5% of that available in the LSA) may potentially be altered due to subsidence (Table 13.7-39). Figure 13.7-48 illustrates the total high-quality black-throated green warbler breeding habitat that may be altered within 200 m buffer zone of the coal seam panels where the effect of subsidence is anticipated to occur. The relative risk of change to black-throated green warbler high-quality breeding habitat is depicted by the number of overlapping panels to be mined, based on the Project Description (Section 3.6), where high-quality black-throated green warbler breeding habitat occurs (Table 13.7-39; Figure 13.7-48).

Table 13.7-39. High-quality Black-throated Green Warbler Breeding Habitat Potentially Altered due to Subsidence

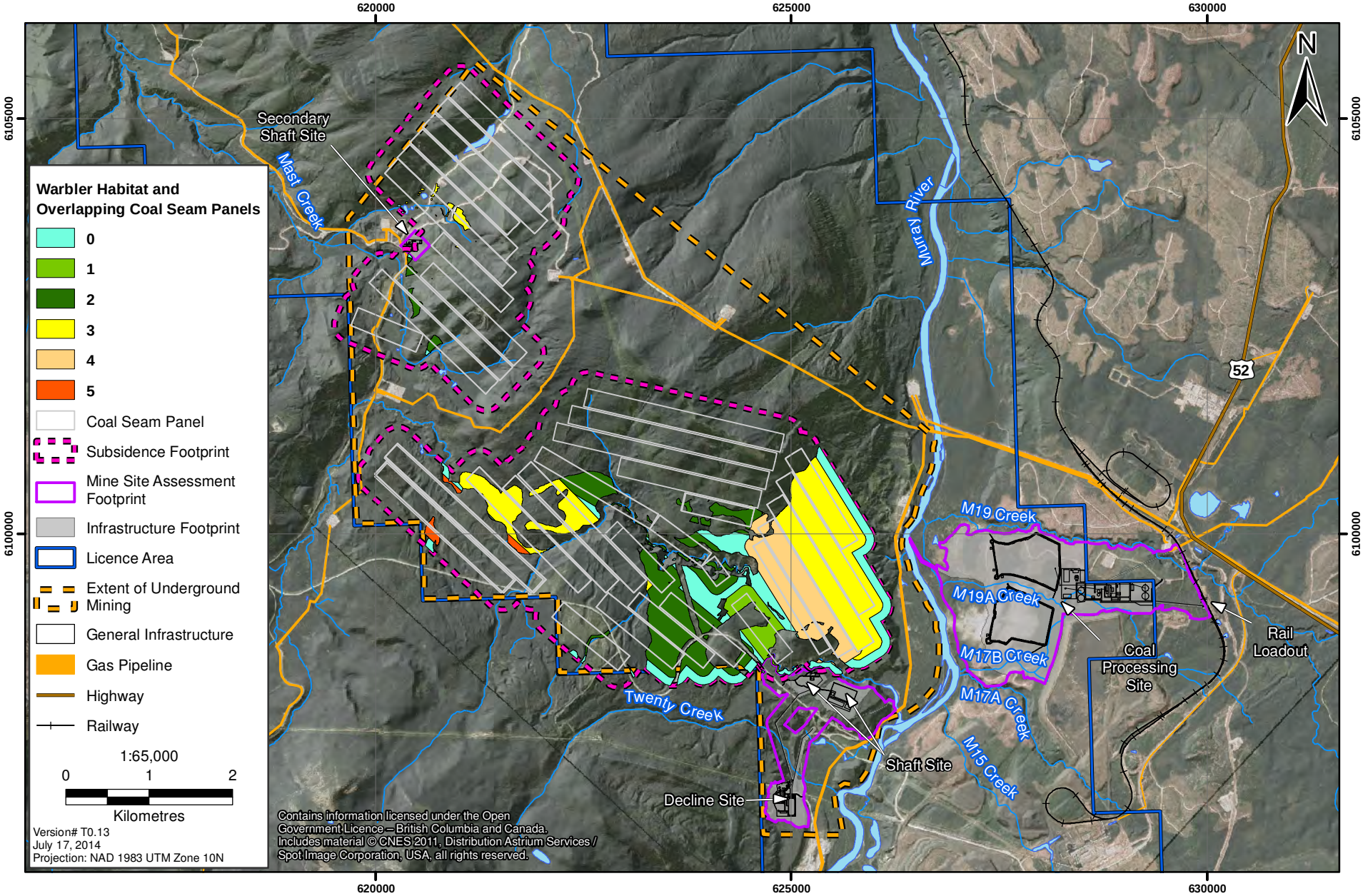
Number of Panels Mined Vertically	Area of High-quality Habitat Potentially Altered (ha)	Regional Study Area		Local Study Area	
		Total High-quality Habitat[1] (ha)	High-quality Habitat Altered (%)	Total High-quality Habitat[1] (ha)	High-quality Habitat Altered (%)
Black-throated Green Warbler Breeding Habitat					
1	24.6				
2	131				
3	194				
4	81.3				
5	6.7				
Total[1]	539	13,081	4.1	4,006	13.5

[1]*Total includes all additional suitable habitat that falls within the 200 m buffered subsidence area around panels, thus includes additional areas where no vertical panels are located.*

It is unclear how breeding habitat quality for black-throated green warbler will change within the zone of subsidence, and not all of the breeding habitat currently available may be lost or altered as a result of subsidence. Thus, the assessment assumes a worst-case scenario whereby calculations are based only on high-quality black-throated green warbler breeding habitat that may be altered as a result of subsidence, but this is potentially an overestimate of actual habitat loss or alteration.

Figure 13.7-48

High-quality Black-throated Green Warbler Breeding Habitat and Number of Overlapping Coal Seam Panels



Residual Effects of Habitat Loss and Alteration for Songbirds

Direct habitat loss and alteration is not predicted to result in a residual effect on songbirds, including SARA-listed species and provincial species of conservation concern, such as the black-throated green warbler. The 237 ha of black-throated green warbler breeding habitat that will be affected accounts for 1.8% of the total amount of suitable nesting habitat available in the RSA and 5.9% of the total amount of suitable nesting habitat available in the LSA. An additional 539 ha could potentially be altered due to the effects of subsidence, however, the direct and indirect effects of subsidence on forest habitat used for black-throated green warbler breeding habitat are likely overestimated since the subsidence won't remove forested cover in the subsidence area.

13.7.17.2 Sensory Disturbance

Sensory disturbance to songbirds due to the Project can occur as a result of continuous noise during Construction and Operation of the Project (Reijnen and Foppen 1995; Fernandez-Juricic, Jimenez, and Lucas 2001; T. Longcore and Rich 2004) and from vehicular traffic noise, as studies have indicated variable effects to songbird density next to roads (Higgins, Naugle, and Forman 2002). Instantaneous noise from train traffic associated with the Project was excluded from the analysis as research indicates that various species of songbirds can habituate to impulse noises such as from railroad traffic (Weinstein 1978).

Elevated noise levels have the potential to mask auditory communication of birds which include breeding calls, alarm calls, territorial calls, contact calls with flocks, and the localization of mates and young (Farabaugh, Dent, and Dooling 1998; Katti and Warren 2004). Bird densities have been found to decrease within 1 km of infrastructure areas (Benitez-Lopez, Alkemade, and Verweij 2010), and a series of studies on birds in grasslands reported that the abundance and diversity of birds began to drop when noise levels reached 47 ± 3.5 dBA near roads (baseline 38 ± 5 dBA; Reijnen and Foppen 1994, 1995; Reijnen, Foppen, and Meeuwsen 1996).

Noise disturbance was calculated by overlaying noise contours for continuous Project-related noise, and instantaneous vehicle traffic with areas of high-quality black-throated green warbler breeding habitat Section 13.6.3.2). The area of high-quality breeding habitat that fell within the 45 dBA noise modelling contour for Project noise was calculated and 75 dBA for vehicle traffic.

Black-throated Green Warbler Breeding Habitat Functionally Lost or Disturbed due to Noise

Continuous Project noise: The total area of high-quality black-throated green warbler breeding habitat within the RSA that may be disturbed due to continuous Project noise after accounting for habitat loss and alteration (Section 13.7.17.1) is 12.4 ha (0.1% of the high-quality songbird breeding habitat in the RSA, 0.3% of the high-quality songbird breeding habitat in the LSA) during Construction and 61.6 ha (0.5% of the high-quality songbird breeding habitat in the RSA, 1.5% of high-quality songbird breeding habitat in the LSA) during Operation (Table 13.7-40). The majority of noise disturbance during Construction will be associated with the construction of the Shaft and Decline Site (Coal Processing Site) and the high-quality breeding habitat affected occurs south of this Shaft and Decline Site (Figure 13.7-49). The majority of noise disturbance during Operation will be

associated with the operation of the Shaft and Decline Site and will occur on the northern portion of this Mine Site Assessment Footprint (Figure 13.7-50).

Table 13.7-40. Functional Loss of High-quality Songbird Habitat due to Sensory Disturbance during Construction and Operation

		Regional Study Area			Local Study Area		
Type of Sensory Disturbance	Project Phase	Total High-quality Habitat (ha)	High-quality Habitat Functionally Lost (ha)	% High-quality Habitat Lost in RSA	High-quality Habitat Available (ha)	High-quality Habitat Functionally Lost (ha)	% High-quality Habitat Lost in LSA
		13,081			4,006		
Continuous Project Noise (45 dBA)							
	Construction		12.4	0.1		12.4	0.3
	Operation		61.6	0.5		61. 6	1.5
Instantaneous Traffic Noise(75 dBA)							
	Construction		22.8	0.2		17.0	0.4
	Operation		19.8	?		13.9	0.3

Instantaneous Traffic Noise: During Construction, the total area of high-quality songbird habitat within the RSA that may be disturbed due to instantaneous traffic noise after accounting for habitat loss and alteration (Section 13.7.17.1) and continuous Project noise is 22.8 ha (0.2% of the suitable songbird habitat in the RSA), and 17.0 ha in the LSA, representing 0.4% of the suitable songbird habitat in the LSA (Table 13.7-40; Figure 13.7-49). During Operation, 19.8 ha of breeding habitat will be disturbed due to instantaneous traffic noise in the RSA (0.2% of the suitable songbird habitat in the RSA) and 13.9 ha will be disturbed in the LSA (0.3% of suitable songbird habitat in the LSA) after accounting for habitat loss and alteration in the Mine Site Assessment Footprint, and continuous Project noise (Table 13.7-40; Figure 13.7-50).

Residual Effects of Sensory Disturbance for Songbirds

Sensory disturbance is not predicted to result in a residual effect on songbirds. Less than 1% of the high-quality habitat in the RSA may be disturbed due to continuous Project noise and vehicle traffic noise during both Construction and Operation.

Mitigation measures to reduce the effects of continuous Project noise (e.g. including noise dampening measures on machinery) and traffic noise (e.g. adhering to speed limits) are detailed in the Wildlife Management Plan (Section 24.12) and listed in Section 13.7.18.2.

Due to the small amount of habitat affected and with mitigation (e.g., pre-clearing surveys), no residual effect of sensory disturbance is predicted for songbirds.

Figure 13.7-49

Black-throated Green Warbler: Functional Habitat Loss of High-quality Habitat due to Noise - Construction

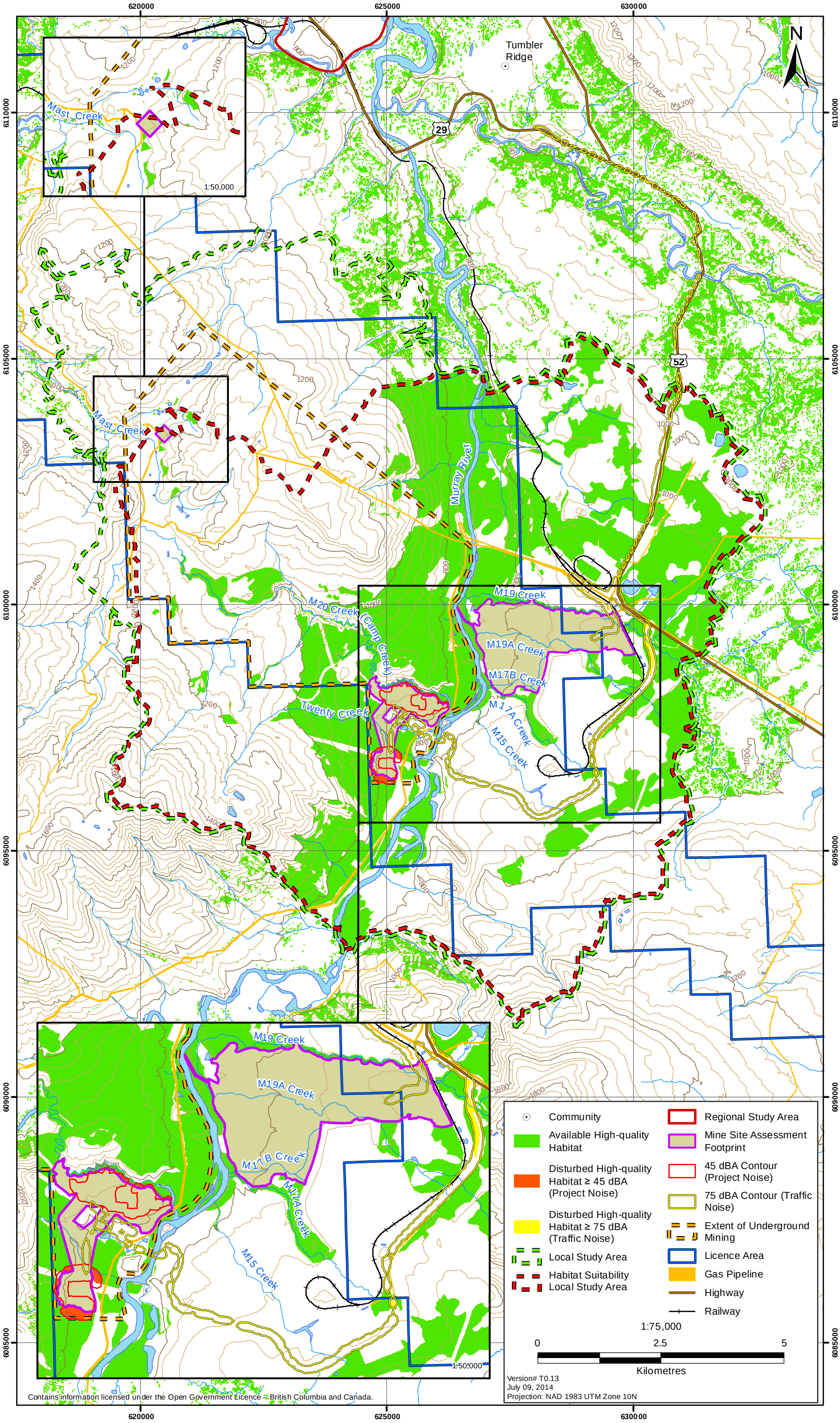
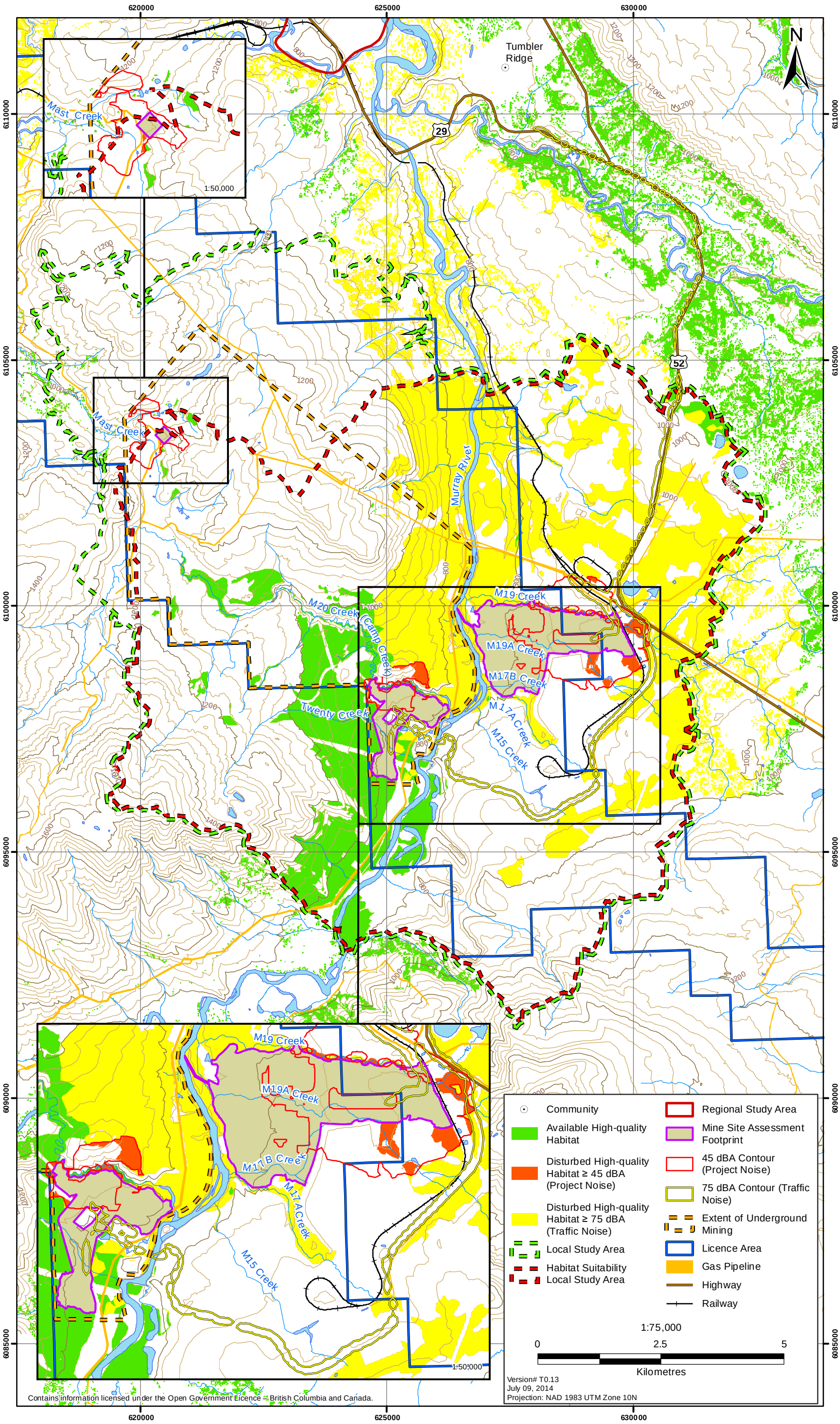


Figure 13.7-50

Black-throated Green Warbler: Functional Habitat Loss of High-quality Habitat due to Noise - Operation



13.7.17.3 Direct Mortality

The potential sources of songbird mortality in association with the Project will be mortality resulting from the destruction of active nest sites.

Construction activities could result in direct mortality of songbirds through clearing of vegetation actively used for nesting. The habitat selected by nesting songbirds is described in Section 13.7.17.1, as well as a quantitative analysis of the amount that will be cleared and lost to habitat loss. The *Wildlife Act* (1996b) specifically protects birds, their nests, and their eggs from possession, molestation, or destruction. Therefore, mitigation measures will be implemented, including timing of vegetation clearing and pre-construction surveys as required.

Residual Effects of Direct Mortality for Songbirds

The effect of direct mortality is not predicted to result in a residual effect on songbirds. The mitigation proposed to limit the effects of habitat loss (Section 13.7.18.1) for songbirds will assist in mitigating the potential for direct mortality effects.

Mitigation for this group will include timing windows for clearing. Pre-clearing surveys within seven days prior to vegetation clearing will be conducted if clearing is to take place during the breeding season (May 1 to July 31). Buffer distances will be established and implemented around identified active nests and will be avoided during the breeding season until nestlings have fledged (Section 13.7.18.1; Section 24.12, Wildlife Management and Monitoring Plan). Because the majority of the available forested habitat within the RSA will remain, with mitigation, no residual effect of direct mortality is predicted for migratory songbirds.

13.7.18 Mitigation Measures for Songbirds

The Wildlife Management Plan (Section 24.12) describes the mitigation and management activities that are designed to reduce or eliminate potential effects to wildlife. Mitigation measures specific to songbirds are described in the following sections.

13.7.18.1 Mitigation for Habitat Loss and Alteration

The effects of habitat loss and alteration on all wildlife, including songbirds will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). Additional mitigation measures for habitat loss and alteration are detailed in Decommissioning and Reclamation (Section 3.9). The potential effects of subsidence will be monitored as per the Subsidence Management Plan (Section 24.15). Mitigation for direct habitat loss and alteration on songbirds will include, but is not limited to:

- avoidance of important habitat where practical alternatives are available (e.g. habitat loss and alteration was minimized through Project design);
- no destruction or disruption of active songbird nests during site clearing during Construction and Operation; and
- re-vegetation of some reclaimed components during Decommissioning and Reclamation.

13.7.18.2 Mitigation for Sensory Disturbance

Mitigation measures for sensory disturbance on all wildlife are discussed in the Wildlife Management Plan (Section 24.12). The effects of sensory disturbance to songbirds will be minimized by mitigating the effects noise (Section 24.3, Noise Management Plan). Guidelines will be followed to minimize the effects of noise on songbirds and other wildlife (Milko 1998).

The following noise mitigation measures will be implemented and are not limited to:

- noise specifications will be considered when selecting equipment to purchase;
- vehicles will be maintained regularly;
- speed limits will be imposed for on-site Project roads;
- mufflers will be installed on vehicles and maintained;
- noise dampening measures will be applied where possible; and
- noise will be monitored periodically at various human and wildlife receptor locations, as part of the Noise Management Plan (Section 24.3) and mitigation strategies will be adjusted accordingly, if required. Noise monitoring locations will be at locations to enable confirmation of noise modelling and effects assessment.

13.7.18.3 Mitigation for Direct Mortality

The effects of direct mortality on all wildlife will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effect of direct mortality will largely be mitigated by the same mitigation measures for habitat loss (Section 13.7.12.1).

Specifically, the effect of direct mortality to songbirds will be mitigated through the following measures:

- scheduling vegetation clearing activities outside of sensitive periods (e.g., breeding from May 1 to July 31 for songbirds), where feasible, and
- where vegetation clearing cannot be conducted outside of sensitive periods, pre-clearing surveys will be conducted by a qualified biologist prior to vegetation clearing during the nesting season.

13.7.19 Key Effects on Waterbirds

Migratory waterbirds were assessed for potential Project related effects. Habitat loss and alteration, sensory disturbance, and direct mortality were included for the effects assessment because those effects have the potential to result in a residual effect. The effects of disruption of movement, attractants, chemical hazards and indirect mortality were scoped out of this assessment for waterbirds.

Disruption of movement is not considered a potential effect for waterbirds as these species can avoid infrastructure by flying around or over obstacles. Tall structures with lights are known to attract birds during nocturnal migrations. Birds can become exhausted while circling lights, and can collide with lit

structures resulting in mortality events (T. Longcore et al. 2013). No tall structures with lights will be constructed for the Project. Thus, disruption of movement is not considered to affect waterbirds.

Waterbirds may be attracted to water storage ponds that may contain water with elevated concentrations of chemicals of potential concern, particularly selenium. This is evaluated under the section on chemical hazards. Note that waterfowl may also use the M19A creek, which is expected to contain selenium concentrations above the wildlife guideline. However, waterfowl will not be present in the M19A creek during the three months of the winter when selenium is expected to be above guidelines and so this potential interaction was scoped out in Section 13.6.3.6 (Chemical Hazards).

Indirect mortality is not considered a potential effect for waterbirds because the primary source of indirect mortality identified for wildlife VCs in association with Project development is increased harvesting pressure due to increased access to the area. No new roads are planned for the Project that will provide new access for hunters and therefore no increase in the area available to hunters is expected.

The potential residual effects considered in the assessment for waterbirds during Construction, Operation, Decommissioning and Reclamation, and Post Closure phases are summarized in Table 13.7-41, and described in Sections 13.7.19.1 to 13.7.19.5.

13.7.19.1 Habitat Loss and Alteration

Waterbirds use habitat in two ways; as staging locations during migration and for foraging during breeding. For most waterfowl, these different uses occur at different times of year – staging during spring and fall migration and foraging during summer. Most waterfowl migrate south and leave the RSA during the winter.

The RSA supports at least 35 different species of waterbirds (Appendix 13-A). Potential effects due to direct habitat loss and alteration on waterbirds were considered because species in this group are afforded protection under the *Migratory Birds Convention Act* (1994a). The nests and eggs of waterbirds are afforded protection under the BC *Wildlife Act* (1996b).

Three groups of waterbirds that occupy different types of habitat have been observed in the RSA during baseline studies: 1) waterbirds, 2) cavity-nesting waterfowl, and 3) riverine birds. Waterbirds (e.g., dabbling ducks, geese) use lakes, swamps, marshes, and shallow open-water wetlands. Cavity-nesting waterfowl (e.g., common goldeneye) nest in mature forested areas, usually within 1 km of suitable wetlands. Riverine birds (e.g., harlequin duck) use montane rivers and streams. Habitat loss and alteration assessments were conducted separately for each of these three waterbird groups due to their varying habitat preferences.

<u>Waterbird Habitat Requirements and Availability</u>

During spring and fall migrations, the highest concentrations of waterbirds were observed along the Murray River in the LSA and the Murray and Wolverine rivers in the RSA but were also located in ponds, creeks and man-made waterbodies during the spring and lakes during the fall.

Table 13.7-41. Ranking Potential Effects on Waterbirds

Project Components/ Physical Activities	Potential Effects on Waterbirds					
	Habitat Loss and Alteration	Sensory Disturbance	Disruption of Movement	Direct and Indirect Mortality	Attractants	Chemical Hazards
Construction						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	L	L	O	L	O	O
Shaft Site	O	L	O	O	O	O
Decline Site	O	L	O	O	O	O
Traffic and Transportation	O	L	O	L	O	O
Operation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	L	O	O	O	O	O
Traffic and Transportation	O	L	O	L	O	O
Decommissioning and Reclamation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	L	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	L	O	L	O	O
Post-Closure						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	O	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	L	O	L	O	O

(-) *No spatial or temporal overlap*

O *Spatial and temporal overlap, but no interaction anticipated; no further consideration warranted.*

L *Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; no monitoring required, no further consideration warranted.*

M *Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*

H *Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

Waterbirds typically construct nests along the edges of waterbodies such as wetlands, marshes, or lakes. Nests are commonly concealed in grasses, clumps of emergent vegetation such as cattails and bulrush, or under riparian vegetation (Campbell et al. 1990). Mallards may nest on the ground up to several hundred metres from water.

Cavity-nesting species, such as bufflehead and mergansers, may nest up to 800 m from water in forested habitat (Pierre, Bears, and Paszkowski 2001). Goldeneyes may nest up to 1.3 km from water (Eadie, Mallory, and Lumsden 1995). Suitable cavities for these species occur in mature and old-growth forest with large trees near water (Campbell et al. 1990).

Riverine species generally build their nests on the ground in riparian areas on mid-stream islands (Robertson and Goudie 1999). A single pair of harlequin duck, a riverine bird and species provincially listed as Vulnerable during the non-breeding season, was observed along a section of the Wolverine River in the RSA during the pre-incubation period (Appendix 13-A, 2010 to 2013 Wildlife Baseline Report). One additional harlequin duck was observed during the spring pair baseline survey conducted in 2010 (Appendix 13-A, 2010 to 2013 Wildlife Baseline Report). No other riverine species were detected during breeding surveys in the RSA.

To evaluate the potential effects of the proposed Project on waterbird habitat, regional and local ecosystem mapping was used to identify potential suitable breeding habitat for waterbirds, cavity nesting waterfowl, and riverine birds.

Waterbird Habitat Availability: Suitable habitat for migrating and breeding waterbirds was identified as lakes, wetlands, marshes, swamps, and shallow open-water wetlands using TEM mapping in the LSA and PEM mapping in the RSA. Within the RSA, 3,720 ha of wetlands were considered suitable for waterbirds, with 257 ha within the LSA (Figure 13.7-51). The majority of suitable waterbird habitat within the LSA was mapped along the east side of the Murray River and west of the north Mine Site Assessment Footprint and the small lakes northeast of Highway 52.

Cavity-nesting Waterfowl Habitat Availability: Suitable habitat for cavity-nesting waterfowl was identified from TEM mapping in the LSA and PEM mapping in the RSA as riparian areas and mature forested habitat within 1 km of an appropriate waterbody (lakes, marshes, swamps, and shallow open-water wetlands). Within the RSA, 106,614 ha of suitable cavity-nesting waterfowl habitat was identified, and 7,566 ha within the LSA. The majority of suitable cavity-nesting habitat within the LSA was mapped on the western side, west of the Murray River with some smaller pockets east of the Murray River.

Riverine Bird Habitat Availability: Suitable habitat for riverine birds was identified as rivers and streams of order two and larger using TEM mapping in the LSA and PEM mapping in the RSA. Suitable riparian habitat along streams was measured in terms of length (km) rather than area. Overall, 1,851 km of suitable riverine bird habitat were identified in the RSA, and 119 km were identified in the LSA. The majority of suitable riverine bird habitat within the LSA was mapped along the Murray River and associated tributaries and creeks.

Waterbird Habitat Loss and Alteration

Habitat Loss and Alteration due to the Mine Site Assessment Footprint

Habitat loss and alteration can occur as a result of clearing activities for the development of Project infrastructure within the Mine Site Assessment Footprints, degradation of wetlands due to the loss of hydrological function, dust inputs, seepage from seepage and sedimentation ponds (see Section 12.7.1.2), and alterations to topography due of subsidence as a result of underground mining.

An analysis was conducted to determine the magnitude of habitat loss and alteration for locally breeding waterbirds, cavity-nesting waterfowl, and riverine birds in the RSA and LSA. The total area of suitable habitat lost or altered within the Mine Site Assessment Footprints was calculated. Habitat loss and alteration for all waterbirds in the RSA and LSA is summarized in Table 13.7-42.

Table 13.7-42. Waterbird, Cavity-nesting Waterfowl, and Riverine Bird Habitat Loss and Alteration within the Project Mine Site Assessment Footprint

		Regional Study Area		Local Study Area	
Waterbird Group	Habitat Lost and Altered (ha)	Total Suitable Habitat (ha)	Suitable Habitat Lost/ Altered (%)	Total Suitable Habitat (ha)	Suitable Habitat Lost/ Altered (%)
Waterbirds	5.2	3,720	0.1	257	0.9
Cavity-nesting waterfowl	149	106,614	0.1	7,566	2.9
Riverine birds[1]	5.9 km	1,851 km	0.3	119 km	5.0

[1] *Area of lost or altered is given in length of stream (km) rather than area.*

Waterbird Habitat Loss and Alteration: A total of 5.2 ha of waterbird habitat will be lost or altered within the Mine Site Assessment Footprint due to the Project during Construction and Operation (Table 13.7-42; Figure 13.7-51). The area lost represents 0.1% of the suitable wetland habitat available in the RSA and 0.9% in the LSA. The small amount of wetland loss will occur as a result of the development of the Coal Processing Site (Figure 13.7-51).

Cavity-nesting Waterfowl Habitat Loss and Alteration: For cavity-nesting waterfowl, the loss or alteration of mature forest within 1 km of wetlands was calculated within the Mine Site Assessment Footprints. A total of 149 ha of suitable cavity-nesting habitat will be lost due to the Project during Construction and Operation (Table 13.7-42). This represents approximately 0.1% of available suitable habitat within the RSA and 2.9% in the LSA. The majority of cavity-nesting habitat will be lost within to the north and south Mine Site Assessment Areas with a small amount lost at the Secondary Shaft Site (Figures 13.7-52).

Riverine Bird Habitat Loss and Alteration: A total of 5.9 km of suitable riverine habitat will be lost or altered (i.e., Project footprint and buffers) due to Project development during Construction and Operation (Table 13.7-42). The total lost or altered habitat represents 0.3% of available riverine habitat in the RSA and 5.0% in the LSA (Figures 13.7-53). The majority of habitat lost is within the north Mine Site Assessment Footprint; with the remaining lost habitat in the south Mine Site Assessment Footprint.

Figure 13.7-51

Waterbird: Habitat Lost due to the Mine Site Assessment Footprint

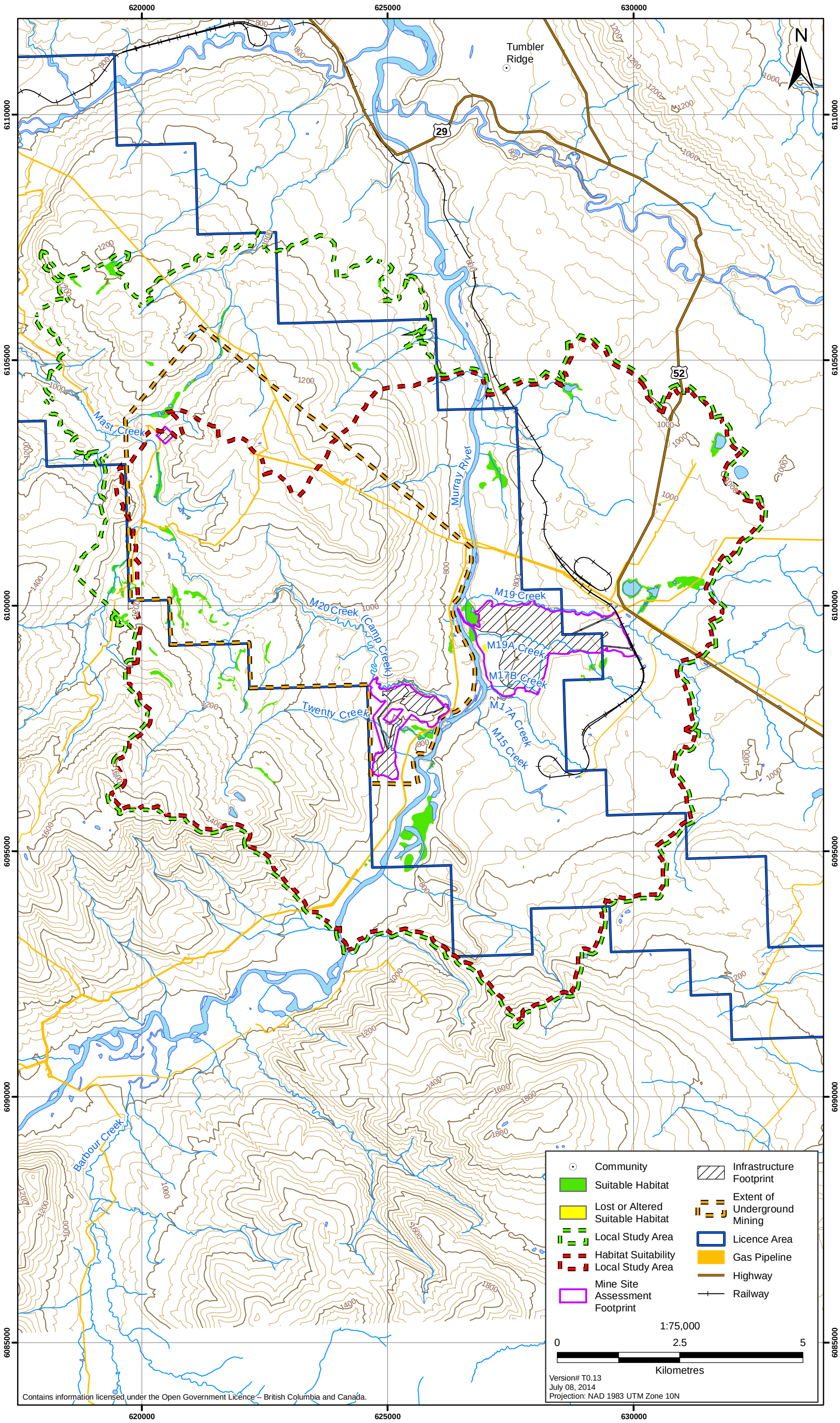


Figure 13.7-52

Cavity-nesting Waterfowl: Habitat Lost due to the Mine Site Assessment Footprint

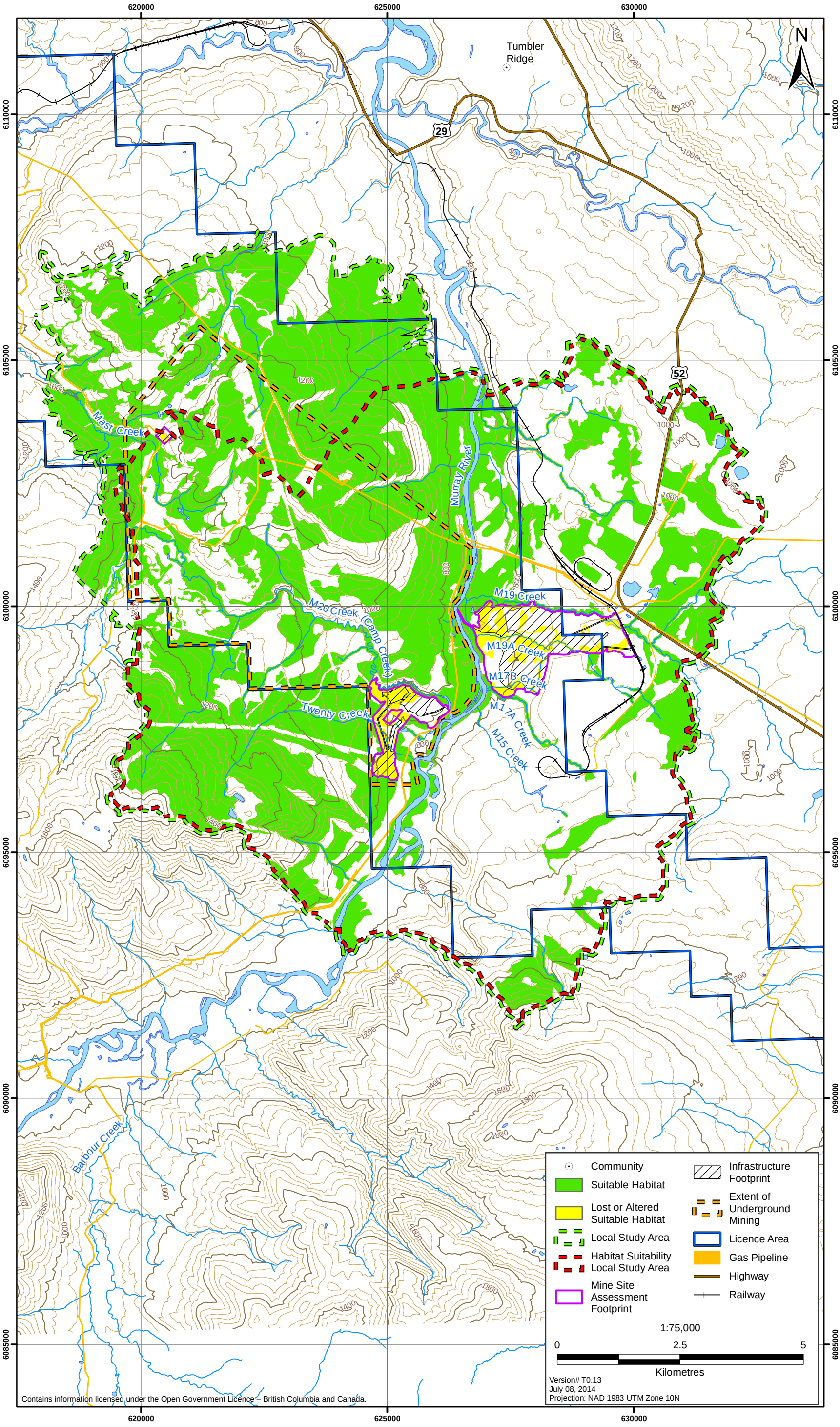
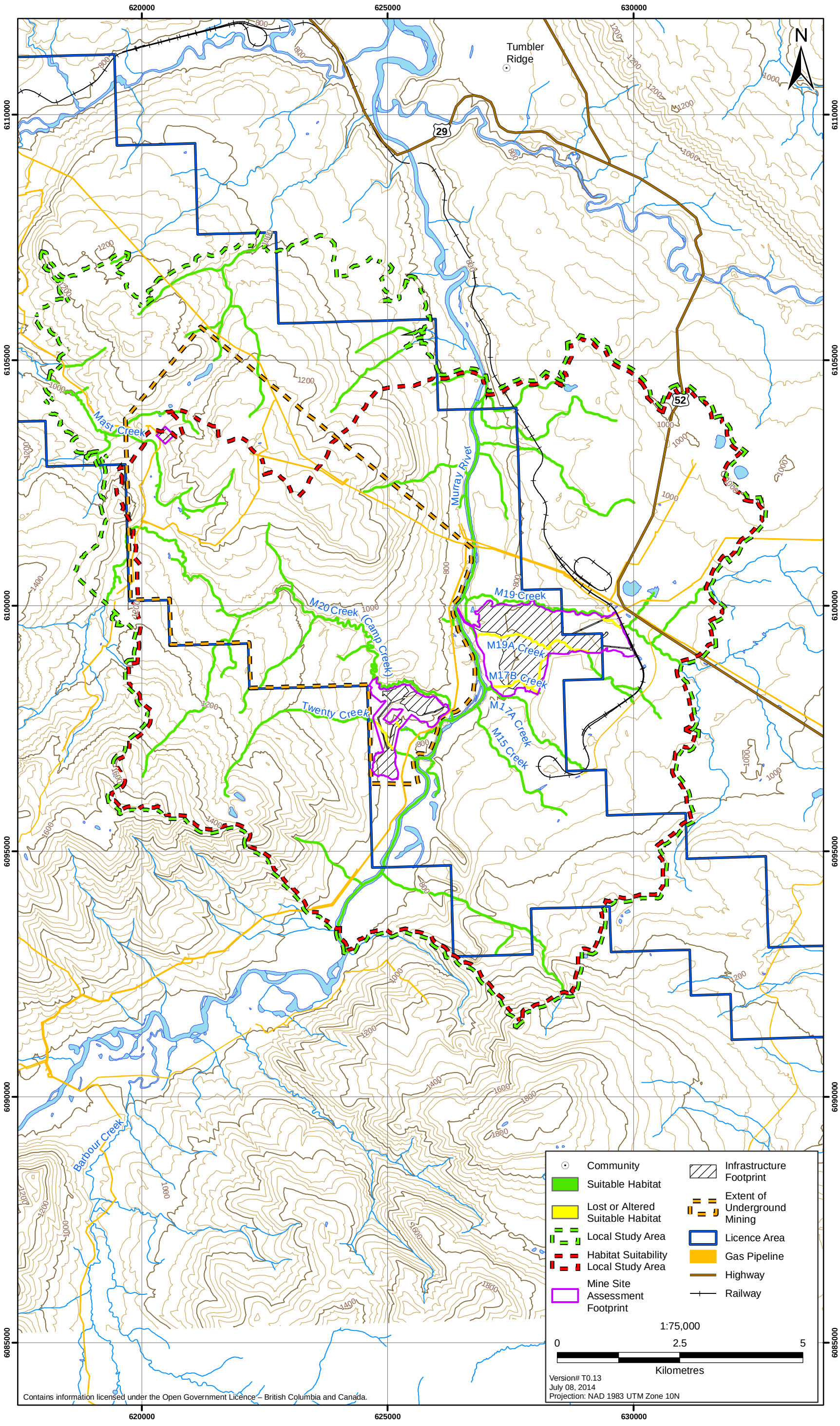


Figure 13.7-53

Riverine Bird: Habitat Lost due to the Mine Site Assessment Footprint



Habitat Degradation Outside of the Mine Site Assessment Footprints

As part of the Wetland Effects Assessment (Chapter 12), a risk-based approach using six components (hydrological connectivity, fragmentation, edge effect, dust, sedimentation and water quality, and invasive species) was employed to assess the probability (low to high) of damage to wetland functions for the Project (Section 12.8). Wetland characteristics used to evaluate waterbird habitat functions and use were based on wildlife baseline identification of bird preference by wetland class (Section 12.8) and probability ratings based on the six components were ranked and summed in these habitats.

Wetland habitat degradation outside of the Mine Site Assessment Footprint is anticipated to result in a total of 40.8 ha of degraded habitat (1.1% of suitable wetland habitat in the RSA and 15.8% in the LSA), of which 12.0 ha have a moderate probability to result in wetland degradation, and 28.7 ha have a low probability to result in wetland degradation (Table 13.7-43). These wetlands occur next to the Murray River west of the Coal Processing Site Mine and southeast of the Shaft and Decline Site, and east of Highway 52 (Figure 13.7-54).

Table 13.7-43. Waterbird Habitat Degradation Outside of the Mine Site Assessment Footprint

		Regional Study Area		Local Study Area	
Probability of Wetland Degradation	Area of Degradation (ha)	Total Suitable Habitat (ha)	Suitable Habitat Degraded (%)	Total Suitable Habitat (ha)	Suitable Habitat Degraded (%)
Low	28.7		0.8		11.2
Moderate	12.0		0.3		4.7
High	0.0		0.0		0.0
Total	40.8	3,720	1.1	257	15.8

Habitat Loss or Alteration due to Subsidence

Subsidence may result in additional habitat loss or alteration for waterbirds. However, it is unclear how waterbird habitat quality will change within the zone of subsidence, and additional suitable waterbird habitat (i.e. wetlands, streams, lakes) may be created as a result of the effects of subsidence on the terrain or, not all of the waterbird habitat currently available may be lost or altered as a result of subsidence. Thus, the assessment assumes a worst-case scenario whereby calculations of the subsidence area plus a 200 m buffer are based only on suitable waterbird habitat that may be lost as a result of subsidence, but this is potentially an overestimate of actual habitat loss or alteration. The relative risk of change to suitable waterbird breeding habitat is depicted by the number of overlapping panels to be mined, based on the Project Description (Section 3.6).

Waterbirds: After accounting for habitat lost due to the Mine Site Assessment Footprint, an additional 41.5 ha of suitable waterbird habitat (0.9% of total suitable habitat available in the RSA, and 12.9% of that available in the LSA) may potentially be altered due to subsidence (Table 13.7-44; Figure 13.7-55).

Cavity-nesting Waterfowl: After accounting for habitat lost due to the Mine Site Assessment Footprint, an additional 1,212 ha of suitable cavity-nesting waterfowl habitat (1.0% of total suitable habitat available in the RSA, and 13.2% of that available in the LSA) may potentially be altered due to subsidence (Table 13.7-44: Figure 13.7-56).

Table 13.7-44. Suitable Waterbird Habitat Potentially Altered due to Subsidence

Waterbird Group	Number of Panels Mined Vertically	Area of Suitable Habitat Potentially Altered (ha)	Regional Study Area		Local Study Area	
			Total Suitable Habitat[1] (ha)	Habitat Altered (%)	Total Suitable Habitat[1] (ha)	Habitat Altered (%)
Waterbird Habitat						
	1	0.0				
	2	9.3				
	3	12.6				
	4	0.0				
	5	11.5				
	Total[1]	33.4	3,720	0.9	257	12.9
	M20 Downstream[2]	0.0				
	Mast Creek Downstream[2]	1.0				
Cavity-nesting Waterfowl Habitat						
	1	152				
	2	296				
	3	434				
	4	60.2				
	5	63.7				
	Total[1]	1,005	106,614	1.0	7,566	13.2
Riverine bird Habitat[3]						
	1	3.3				
	2	7.8				
	3	3.5				
	4	0.2				
	5	1.4				
	Total[1]	16.2	1,851 km	0.9	119 km	13.6
	M20 downstream[2]	2.7				
	Mast Creek downstream[2]	2.3				

[1]Total includes all suitable habitat that falls within the 200 m buffered subsidence area around panels, thus includes additional areas where no vertical panels are located.
[2]M20 and Mast Creek Downstream refer to wildlife habitat outside of the 200 m buffered subsidence zone that may be affected by the effects of subsidence, most notably a change in hydrology
[3]Riverine bird habitat is reported in km

Riverine Birds: After accounting for habitat lost due to the Mine Site Assessment Footprint, an additional 21.2 km of suitable riverine bird habitat (0.9% of total suitable habitat available in the RSA, and 13.6% of that available in the LSA) may potentially be altered due to subsidence (Table 13.7-44: Figure 13.7-57).

Figure 13.7-54

Predicted Degradation of Suitable Waterbird Habitat as a Result of Project Activities

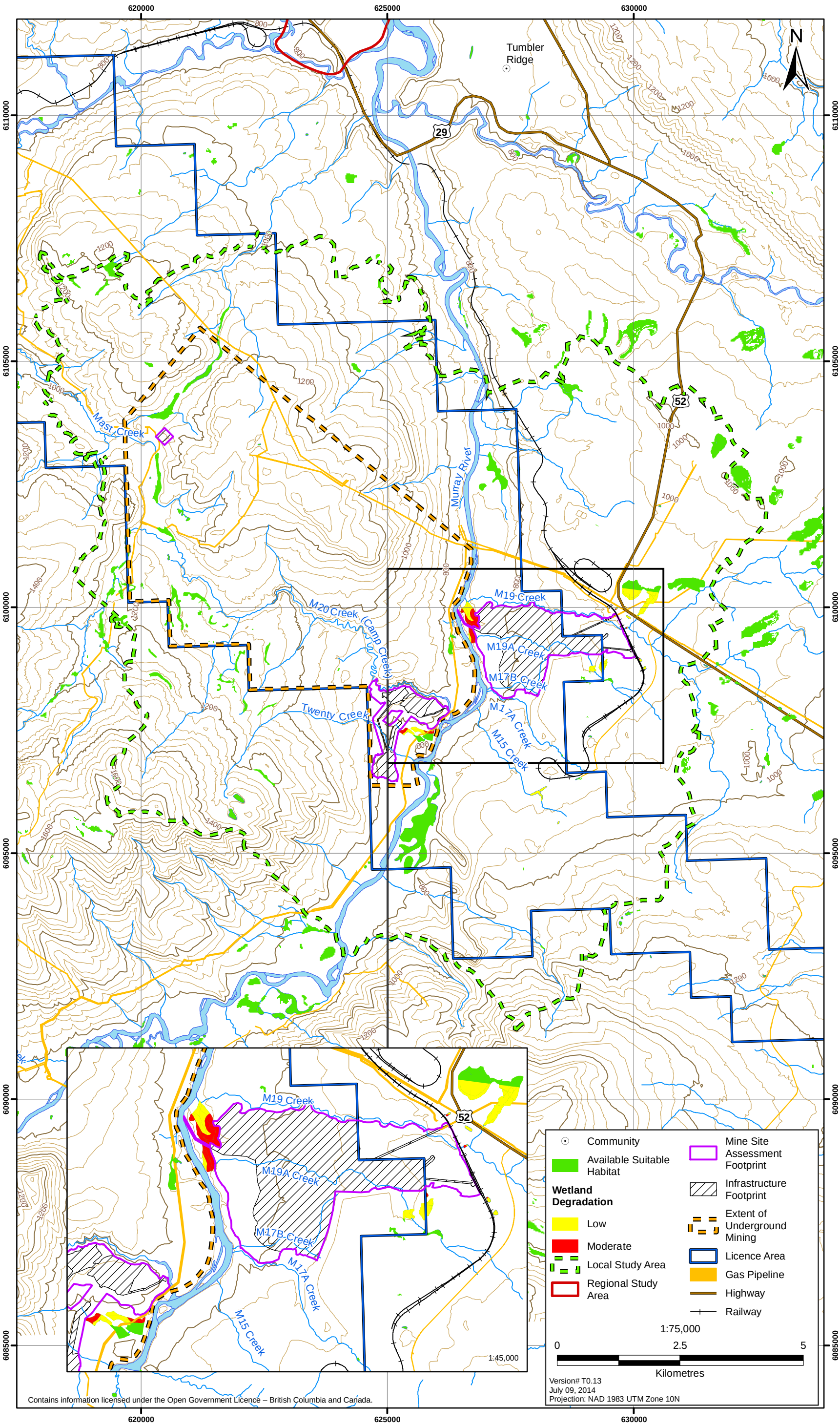


Figure 13.7-55

Suitable Waterbird Habitat and Number of Overlapping Coal Seam Panels

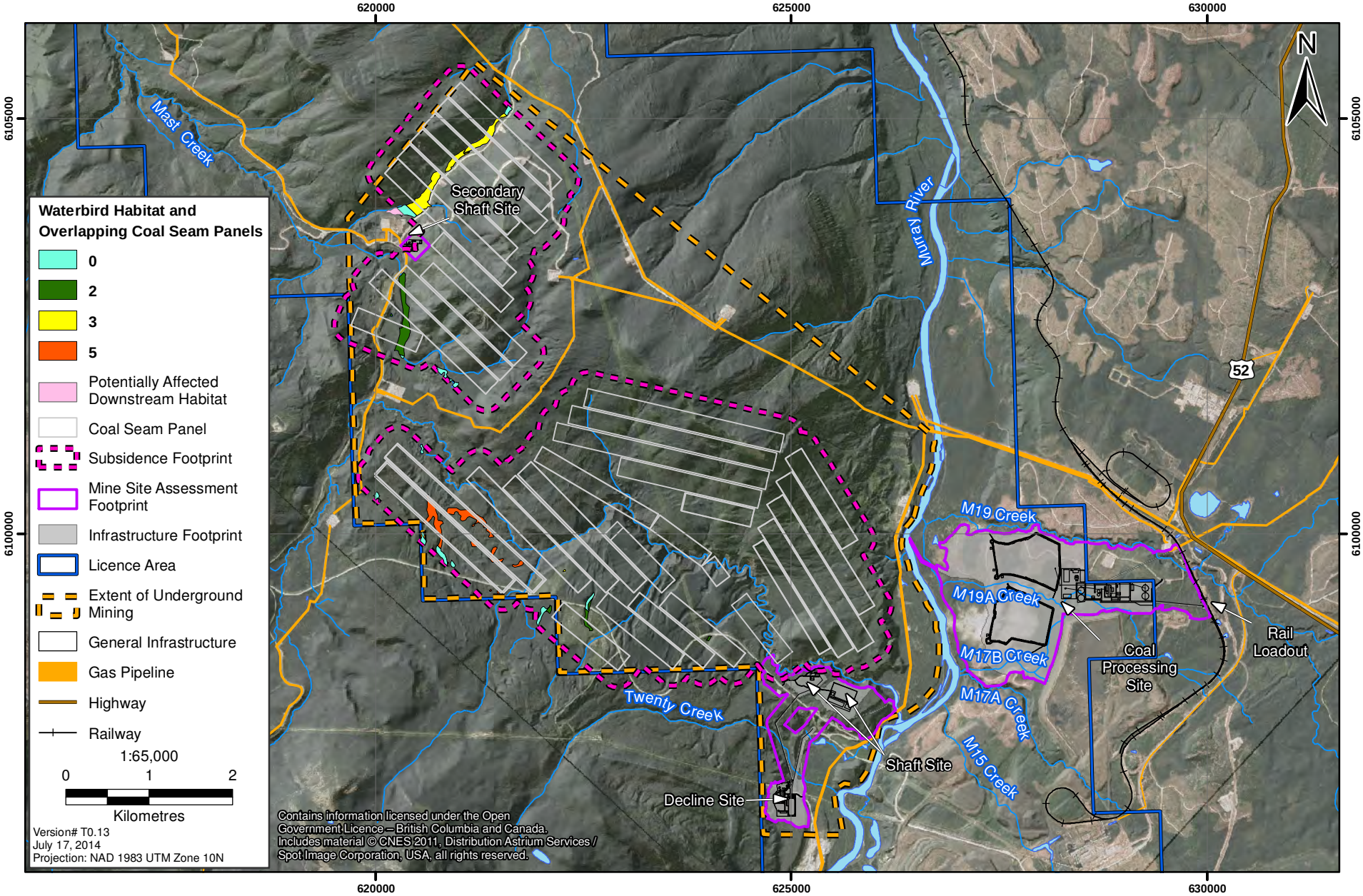


Figure 13.7-56

Suitable Cavity-nesting Waterfowl Habitat and Number of Overlapping Coal Seam Panels

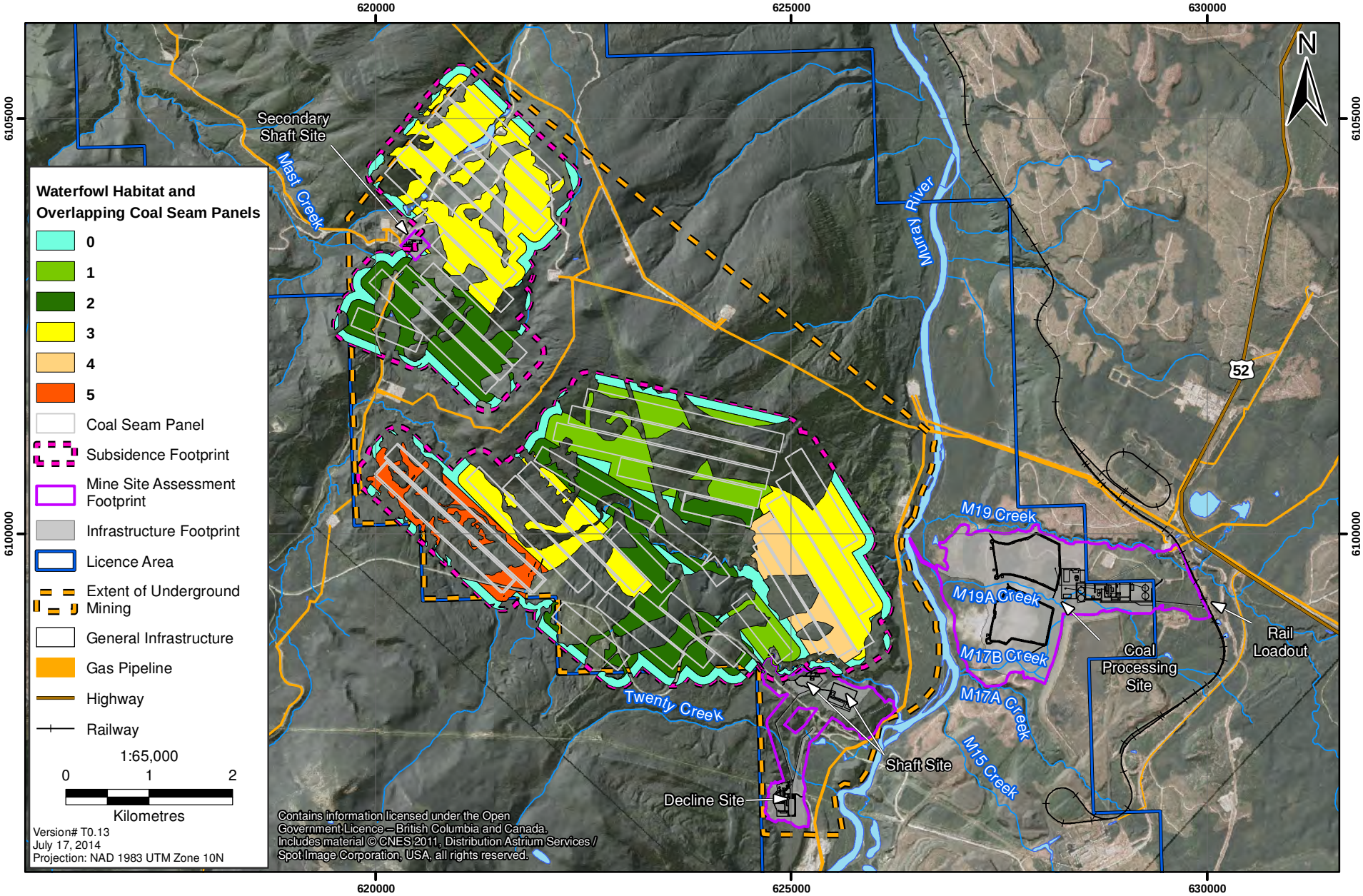
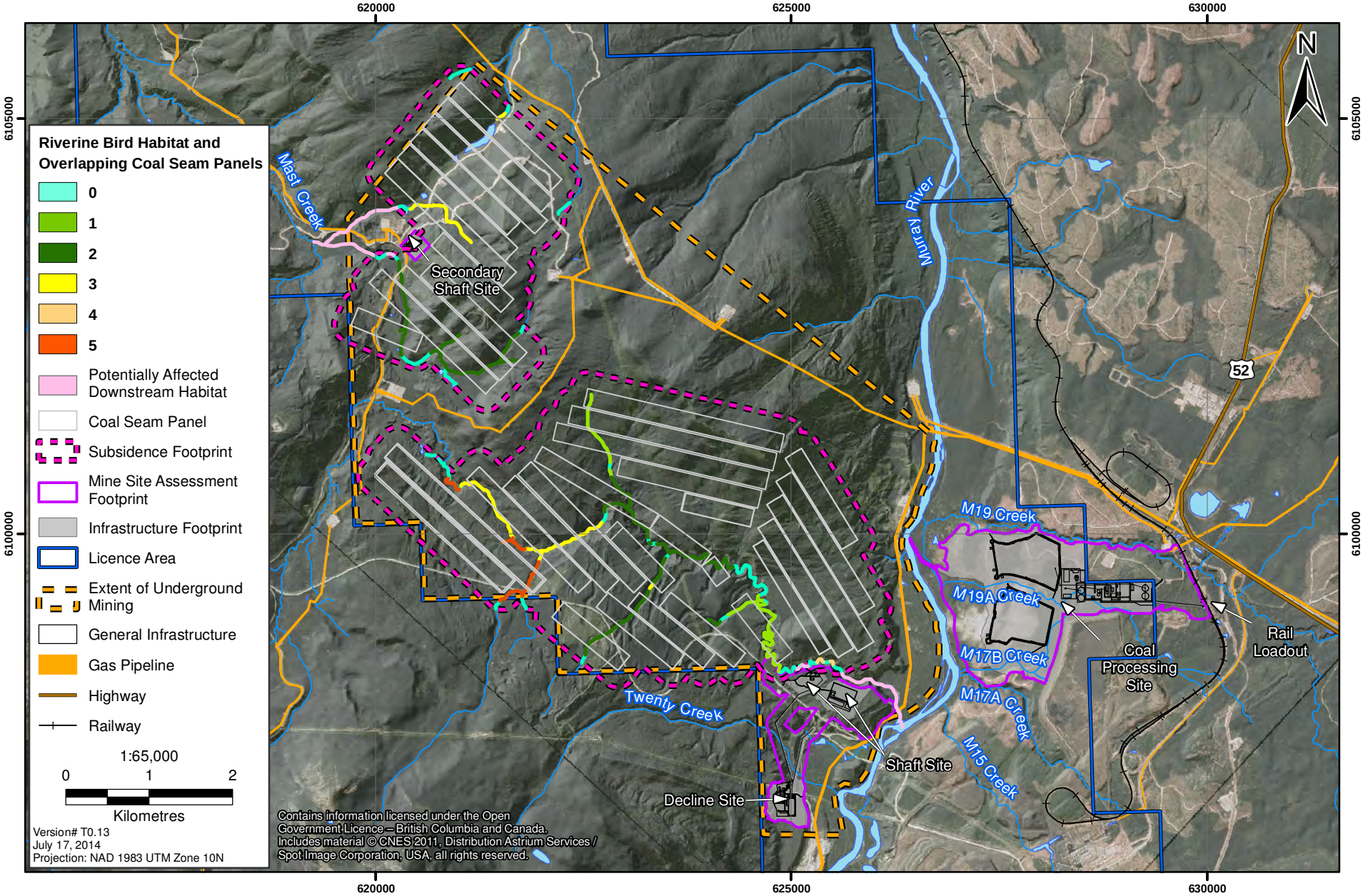


Figure 13.7-57

Suitable Riverine Bird Habitat and Number of Overlapping Coal Seam Panels



Residual Effects of Habitat Loss and Alteration for Waterbirds

The effect of habitat loss and alteration is not predicted to result in a residual effect for migratory waterbirds. Waterbird habitat loss and alteration will occur within the RSA and LSA; however, the loss of habitat due to the Mine Site Assessment Footprint is minimal (less than 0.3% suitable habitat within the RSA for each waterbird group). A total of 40.8 ha of wetland habitat (1.1% of the suitable habitat for waterbirds in the RSA) are also anticipated to be degraded outside of the Mine Site Assessment Footprint due to Project activities. Subsidence may alter additional high-quality habitat for each waterbird group (1.1% of the suitable habitat for each of waterbirds, cavity-nesting waterfowl, and riverine birds). However, the direct and indirect effects of subsidence on suitable habitat used by each group of waterbird are likely overestimated and it is possible that some habitat, especially for waterbirds, could be created. Thus, the total habitat loss and alteration is anticipated to be less than 1.4% for cavity-nesting waterfowl, and riverine birds, and less than 2.4% of the RSA for waterbirds, with the possibility of some habitat creation for waterbirds. It is anticipated that this loss of habitat will not result in a decrease to carrying capacity of the regional population, and it is expected that birds will establish other nesting territories elsewhere in the region and the disruption will be temporary, if not beneficial for some species (e.g. waterbirds).

13.7.19.2 Sensory Disturbance

Sensory disturbance to waterbirds due to the Project can occur as a result of elevated continuous Project-noise during Construction and Operation of the Project (Reijnen and Foppen 1995; Fernandez-Juricic, Jimenez, and Lucas 2001; T. Longcore and Rich 2004); and from instantaneous noise sources such as vehicle traffic associated with the Project. Instantaneous noise from train traffic associated with the Project was excluded from the analysis as research indicates that many species of waterbirds can habituate to noise from railroad traffic (Dwyer and Tanner 1992).

The potential consequences of disturbance include functional loss of habitat due to avoidance, increased energetic costs due to decreased foraging time and increased flying time, nest abandonment and increased predation rates, and reduced reproductive success (Hockin et al. 1992).

Noise disturbance was calculated by overlaying noise contours for continuous Project-related noise, and instantaneous vehicle traffic noise with areas of suitable waterbird, cavity-nesting waterfowl, and riverine bird breeding habitat as described in Section 13.6.3.2.

Waterbird Habitat Functionally Lost or Disturbed due to Noise

Sensory disturbance for all waterbirds in the RSA and LSA is summarized in Table 13.7-45.

Waterbirds

Continuous Project noise: No suitable wetland habitat is affected by Project noise during Construction. During Operation, the total wetland area that will be functionally lost or disturbed as waterbird habitat within the 45 dBA and greater sound contour is 7.7 ha (0.2% of the suitable wetland habitat in the RSA and 3% of that in the LSA) after accounting for habitat lost or altered due to the Mine Site Assessment Footprints (Section 13.7.19.1; Table 13.7-45). The majority of the habitat affected by Project noise during Operation is located outside of the Mine Site Assessment Footprints and to the south of the north Mine Site Assessment Footprint and is associated with activities conducted within the north Mine Site Assessment Footprint at the Coal Processing Site (see Figure 13.7-59).

Table 13.7-45. Functional Loss of Suitable Waterbird Habitat due to Sensory Disturbance during Construction and Operation

Waterbird Group	Type of Sensory Disturbance	Project Phase	Regional Study Area			Local Study Area		
			Total Suitable Habitat (ha)	Suitable Habitat Functionally Lost (ha)	% Suitable Habitat Lost in RSA	Total Suitable Habitat (ha)	Suitable Habitat Functionally Lost (ha)	% Suitable Habitat Lost in LSA
Waterbirds			3,720			257		
	Continuous Project Noise (45 dBA)							
		Construction		0	0.0		0	0.0
		Operation		8	0.2		8	3.0
	Instantaneous Traffic Noise(75 dBA)							
		Construction		2	0.05		2	0.8
		Operation		2	0.05		2	0.8
Cavity-nesting Waterfowl			106,614			7,566		
	Continuous Project Noise (45 dBA)							
		Construction		12	0.01		12	0.2
		Operation		93	0.09		93	1.2
	Instantaneous Traffic Noise(75 dBA)							
		Construction		30	0.03		17	0.2
		Operation		29	0.03		15	0.2
Riverine bird[2]			1,851 km			119 km		
	Continuous Project Noise (45 dBA)							
		Construction		0.16 km	0.01		0.2 km	0.1
		Operation		3.8 km	0.2		4 km	3.2
	Instantaneous Traffic Noise(75 dBA)							
		Construction		1 km	0.06		1 km	0.7
		Operation		1 km	0.05		0.6 km	0.5

[1] *Suitable habitat refers to high-quality habitat in the RSA and LSA; see text for definition of high-quality habitat.*

[2] *Area of functional habitat lost is given in length of stream (km) rather than area.*

Note: Percentages recorded in the LSA don't always add up as some area of suitable habitat falls outside of the LSA.

Instantaneous Traffic Noise: The total suitable waterbird habitat that will be disturbed due to instantaneous traffic noise within the 75 dBA or greater sound contour is 2.0 ha (0.05% of the RSA and 0.8% of the LSA) during both Construction (Table 13.7-45; Figure 13.7-58) and Operation (Table 13.7-45; Figure 13.7-59).

Cavity-nesting Waterfowl

Continuous Project noise: After accounting for habitat lost and altered due to the Mine Site Assessment Footprints (Section 13.7.19.1), the total area of cavity-nesting waterfowl habitat that will be functionally lost or disturbed within the 45 dBA and greater sound contour is 12.1 ha (0.01% of the suitable cavity-nesting habitat in the RSA, 0.2% of that available in the LSA) during Construction (Table 13.7-45; Figure 13.7-60) and 93.0 ha (0.09% of the suitable cavity-nesting habitat in the RSA and 1.2% of that available the LSA) during Operation (Table 13.7-45; Figure 13.7-61). The disturbed habitat due to Project noise during Construction is associated with the construction activities at the Shaft and Decline Site Mine Site Assessment Footprint (Figure 13.7-60), and during Operation is associated with Project activities at both the Shaft and decline Site and Coal Processing Site Mine Site Assessment Footprints as well as at the Secondary Shaft Site (Figure 13.7-61).

Instantaneous Traffic Noise: After accounting for habitat lost and altered due to the Mine site assessment Footprints (Section 13.7.19.1) and that functionally lost to continuous Project noise, the total suitable cavity-nesting waterfowl habitat that will be disturbed during Construction due to instantaneous traffic noise within the 75 dBA or greater sound contour is 30.3 ha in the RSA (0.03% of the suitable cavity-nesting habitat in the RSA; Table 13.7-45; Figure 13.7-60), and 16.9 ha in the LSA (0.22% of the suitable cavity-nesting habitat available in the LSA; Table 13.7-45; Figure 13.7-61). During Operation, the total suitable cavity-nesting waterfowl habitat that will be disturbed due to instantaneous traffic noise is 28.7 ha in the RSA (0.03% of the suitable habitat in the RSA: Table 13.7-45; Figure 13.7-61), and 15.3 ha in the LSA (0.20% of the suitable habitat in the LSA.

Riverine Bird:

Continuous Project noise: After accounting for habitat lost or altered due to the Mine Site Assessment Footprint (Section 13.7.19.1), the total length of riverine habitat that will be functionally lost or disturbed within the 45 dBA and greater sound contour is 0.16 km (0.01% of the suitable riverine habitat in the RSA, 0.13% of that in the LSA) during Construction (Table 13.7-45; Figure 13.7-62), and 3.8 km (0.2% of suitable habitat in the RSA, 3.2% of suitable habitat in the LSA) during Operation (Table 13.7-45; Figure 13.7-63). During Construction, the disturbance will occur primarily south of the Shaft and Decline Site Mine Site Assessment Footprint as a result of construction activities within this footprint (Figure 13.7-62). During Operation, the disturbance will occur primarily to the west of the Coal Processing Site Mine Site Assessment Footprint and north of the Secondary Shaft Site Mine Assessment Footprint due to construction and operation activities occurring in these footprints (Figure 13.7-63).

Instantaneous Traffic Noise: During Construction, the total suitable riverine bird habitat that will be disturbed due to instantaneous traffic noise within the 75 dBA or greater sound contour is 1.1 km in the RSA (0.06% of the suitable habitat in the RSA; Table 13.7-45; Figure 13.7-62) and 0.8 km in the LSA (0.7% of the suitable habitat in the LSA). During Operation, the total suitable riverine bird habitat that will be disturbed due to instantaneous traffic noise is 0.9 km in the RSA (0.05% of the suitable habitat in the RSA; Table 13.7-45; Figure 13.7-63) and 0.6 km in the LSA (0.5% of the suitable habitat in the LSA).

Figure 13.7-58

Waterbird: Functional Habitat Loss of Suitable Habitat due to Noise - Construction

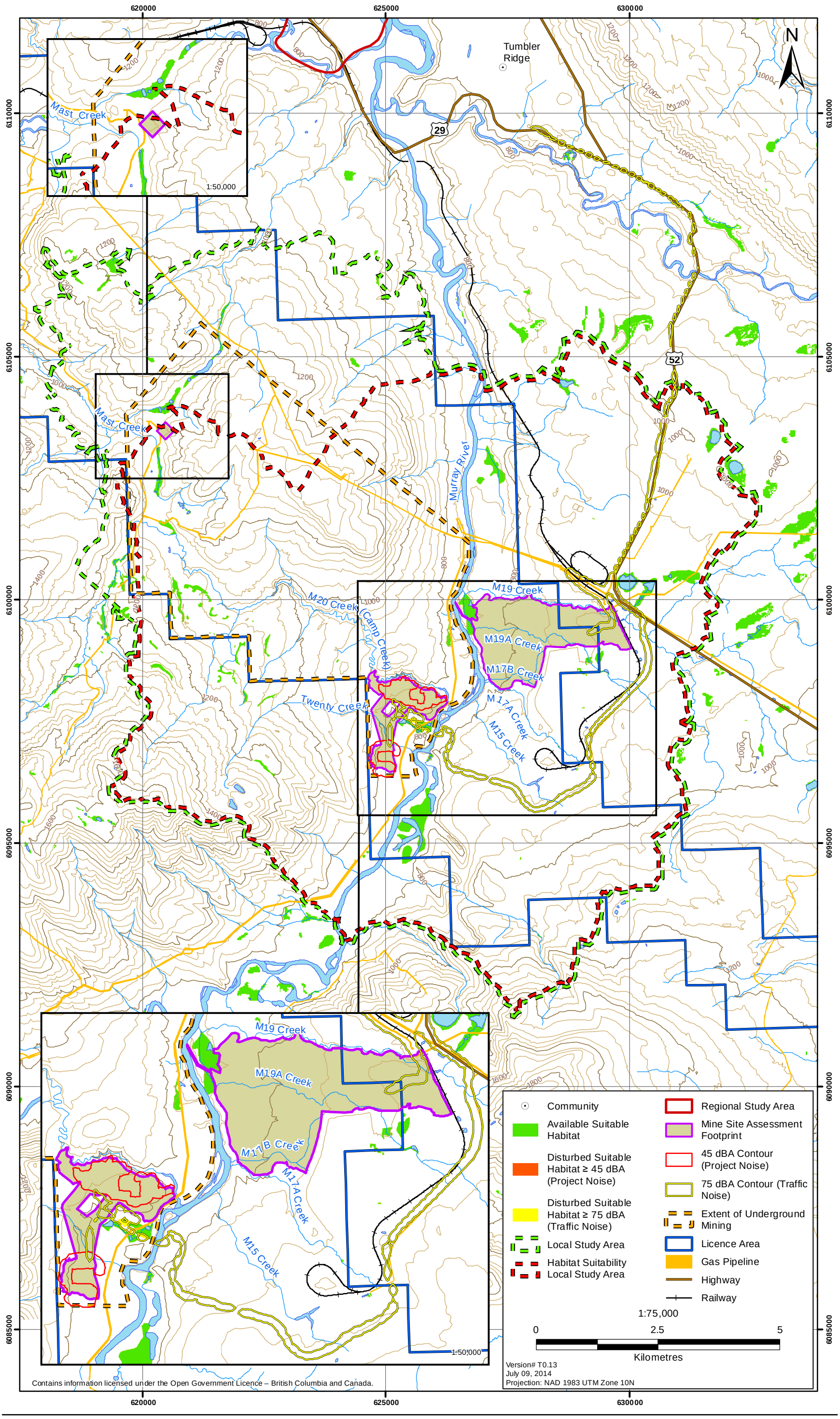


Figure 13.7-59

Waterbird: Functional Habitat Loss of Suitable Habitat due to Noise - Operation

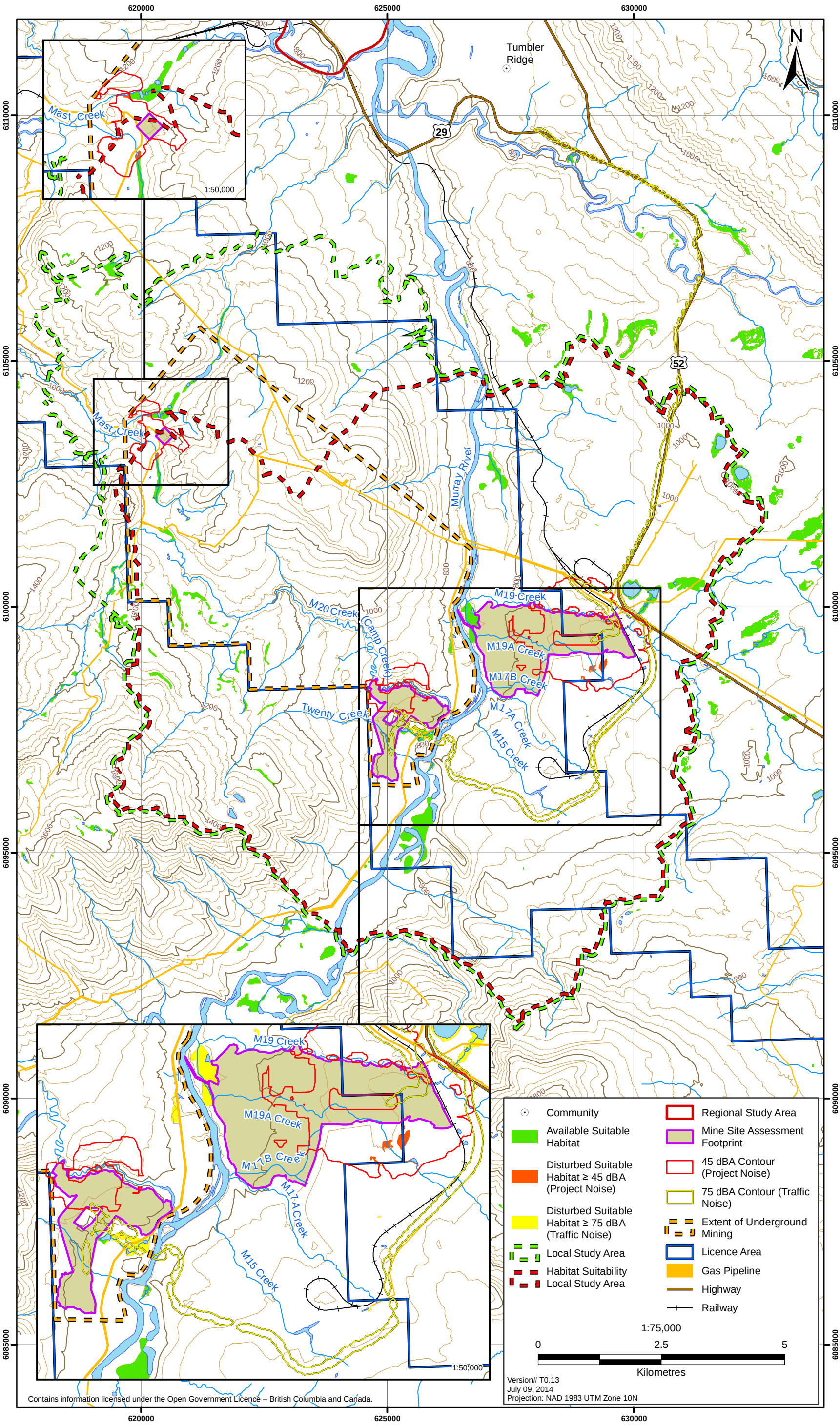


Figure 13.7-60

Cavity-nesting Waterfowl: Functional Habitat Loss of Suitable Habitat due to Noise - Construction

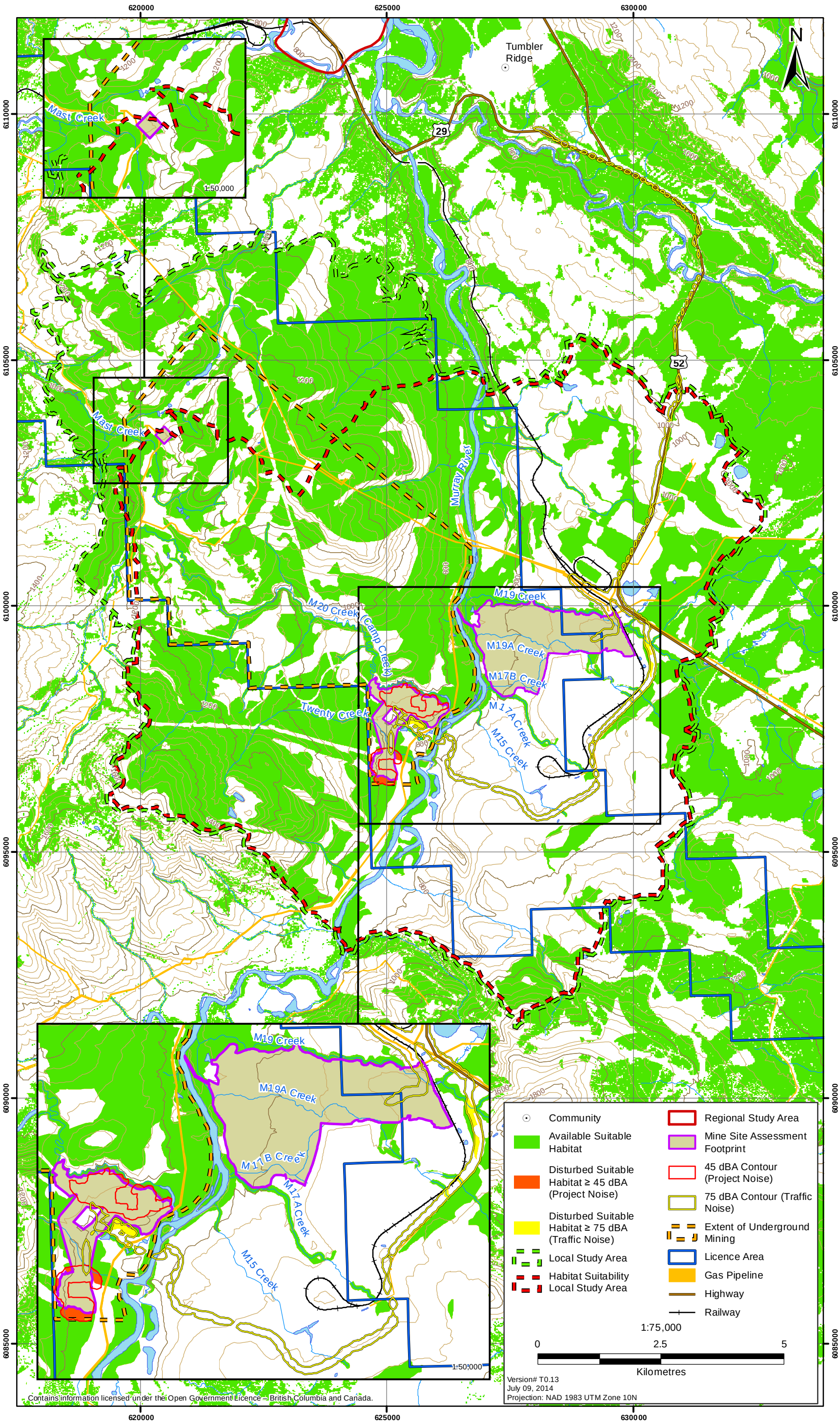


Figure 13.7-61

Cavity-nesting Waterfowl: Functional Habitat Loss of Suitable Habitat due to Noise - Operation

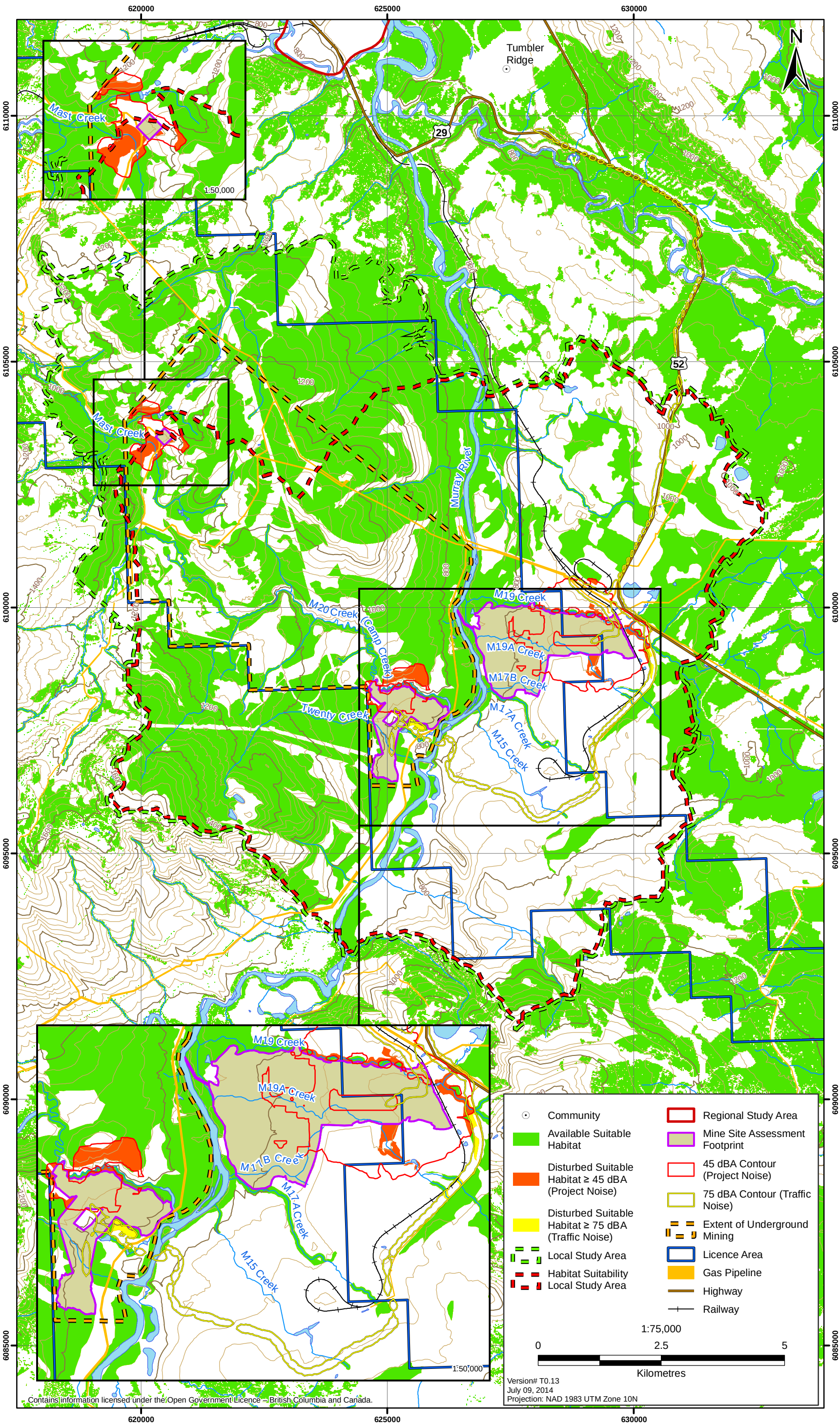


Figure 13.7-62

Riverine Bird: Functional Loss of Suitable Habitat due to Noise - Construction

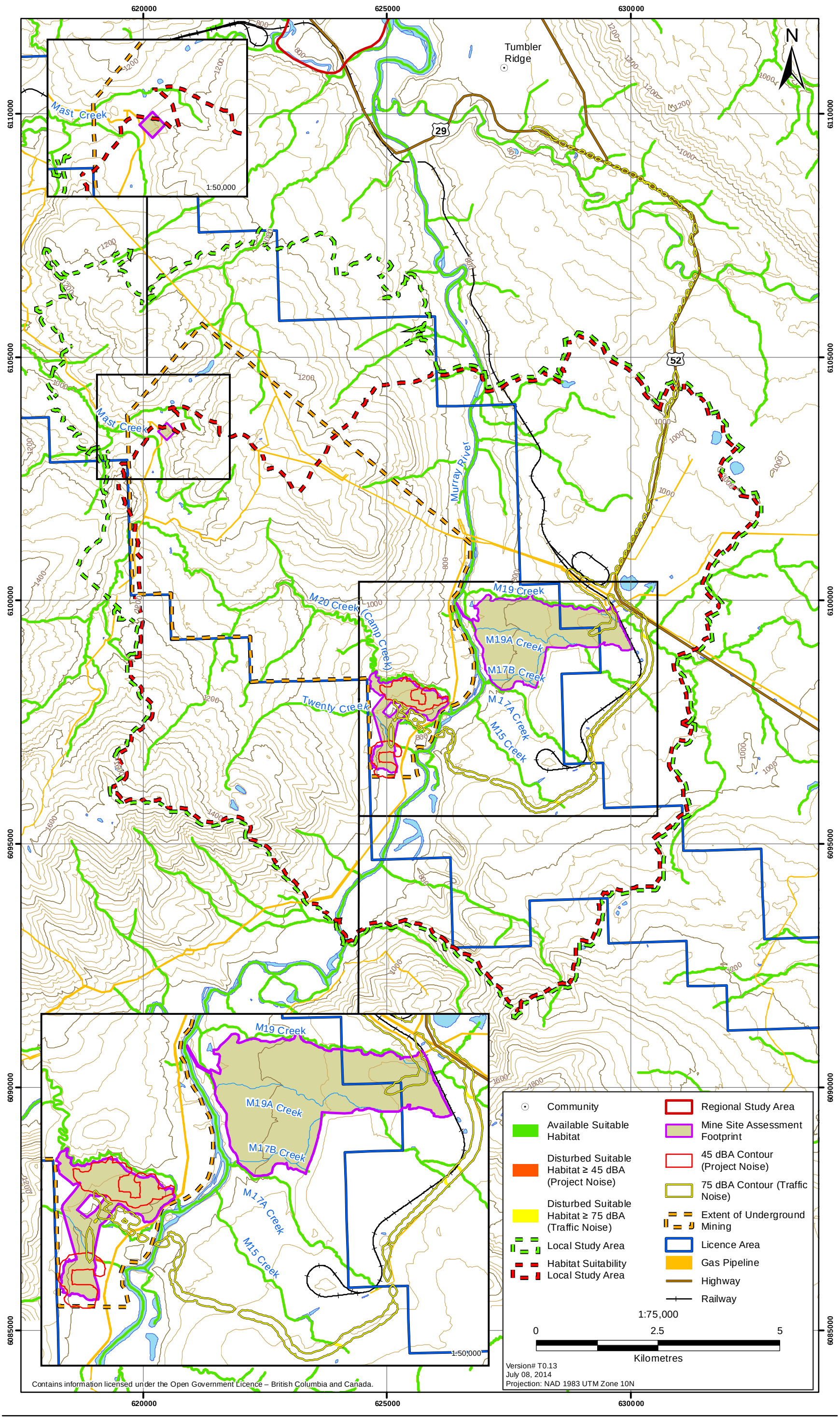
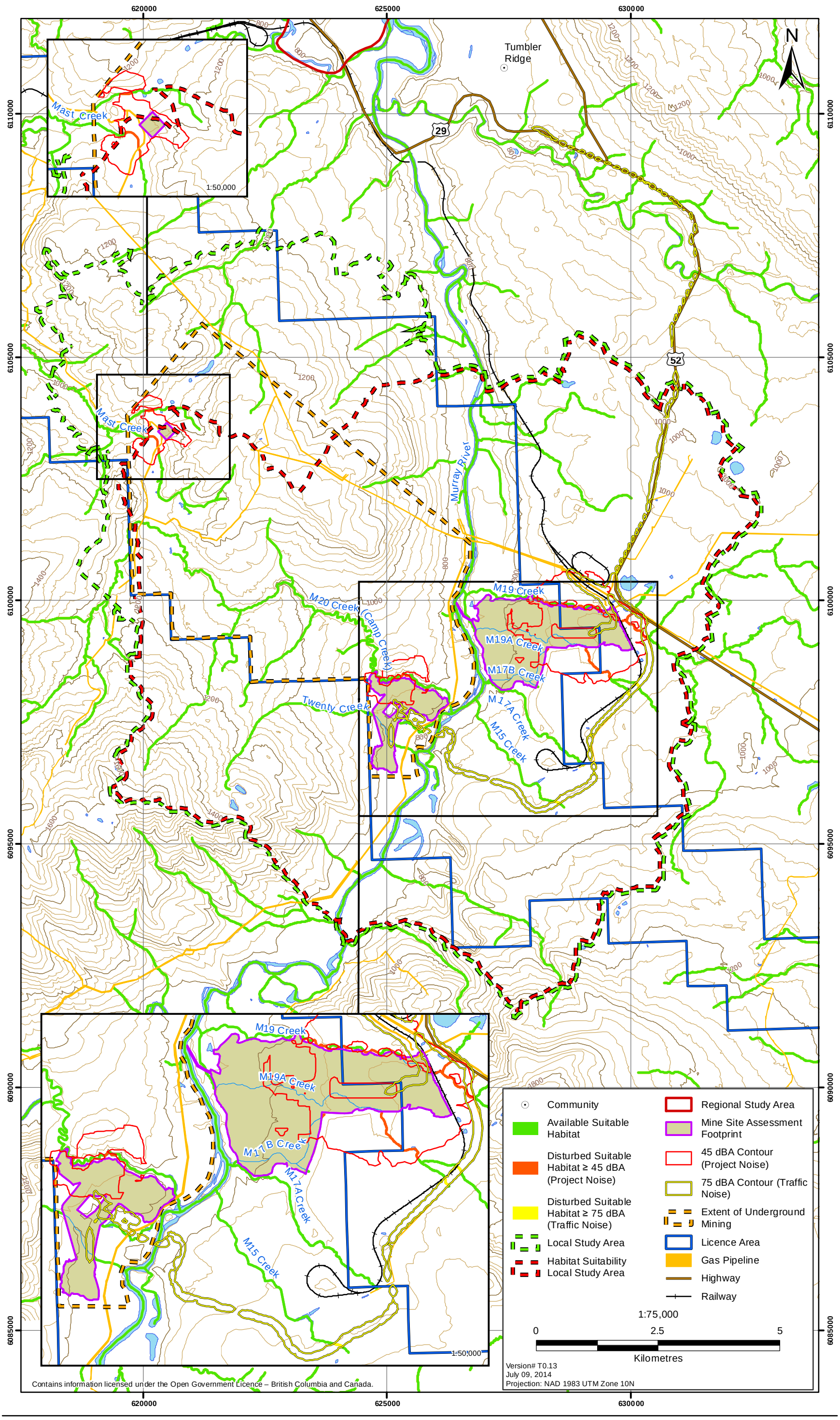


Figure 13.7-63

Riverine Bird: Functional Habitat Loss of Suitable Habitat due to Noise - Operation



Residual Effects of Sensory Disturbance for Waterbirds

Sensory disturbance is not predicted to result in a residual effect on waterbirds. Less than 1% of the available habitat in the RSA may be disturbed due to continuous Project noise and vehicle traffic noise during both Construction and Operation.

Mitigation measures to reduce the effects of continuous Project noise (e.g. including noise dampening measures on machinery) and traffic noise (e.g. adhering to speed limits) are detailed in the Wildlife Management Plan (Section 24.12) and listed in Section 13.7.20.2.

Due to the small amount of habitat affected and with mitigation (e.g., pre-clearing surveys), no residual effect of sensory disturbance is predicted for waterbirds.

13.7.19.3 Direct Mortality

The potential source of migratory waterbird mortality in association with the Project is nest destruction during clearing.

Construction activities could result in direct mortality of waterbirds through clearing of vegetation that is used for nesting. The habitat selected by nesting birds is described in Section 13.7.9.1 as well as a quantitative analysis of the amount that will be cleared. The *Wildlife Act* (1996b) specifically protects birds, their nests, and their eggs from possession, molestation, or destruction. Therefore, mitigation measures will be implemented that include recommendations for the timing of vegetation clearing and pre-construction surveys as required (see Section 13.7.20.3).

Residual Effects of Direct Mortality for Waterbirds

The effect of direct mortality is not predicted to result in a residual effect on waterbirds. Mitigation measures to reduce the effects of direct mortality on waterbirds and other wildlife are detailed in the Wildlife Management Plan (Section 24.12). The mitigation proposed to limit the effects of habitat loss (Section 13.7.20.1) and direct mortality (Section 13.7.20.3) for waterbirds will assist in lessening the potential for direct mortality effects. Pre-clearing surveys for active nests would be conducted before clearing if development activities take place during the breeding season (April 1 to July 31; Section 24.12, Wildlife Management and Monitoring Plan).

13.7.19.4 Chemical Hazards

During Operation, water storage ponds are predicted to contain chemicals that will exceed the guidelines for wildlife species. Selenium is predicted to occur above wildlife guidelines, among others, and has been identified as a chemical of potential concern for waterfowl (Section 13.6.3.6). The Project will be monitoring water quality in all Project ponds and if ponds contain chemicals above wildlife guidelines, appropriate mitigation will be applied to exclude wildlife from these ponds. Waterfowl exclusion is practiced successfully at a variety of industrial sites and is a well understood mitigation activity (Section 13.7.20.4). Hence, no residual effects due to chemical hazards in water storage ponds are predicted for the Project.

Note that discharge from the Project into M19A creek was also predicted to contain concentrations of selenium above wildlife guidelines during the winter. Waterfowl are not present during the winter and so will not be exposed to selenium in M19A creek. Exposure due to this route was scoped out of the assessment in Section 13.6.3.6.

13.7.20 Mitigation Measures for Waterbirds

The Wildlife Management Plan (Section 24.12) describes the mitigation and management activities that are designed to reduce or eliminate potential effects to wildlife. Mitigation measures specific to waterbirds are described in the following sections.

13.7.20.1 Mitigation for Habitat Loss and Alteration

The effects of habitat loss and alteration on all wildlife, including waterbirds will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.2). Additional mitigation measures for habitat loss and alteration are detailed in Decommissioning and Reclamation (Section 3.9). The potential effects of subsidence will be monitored as per the Subsidence Management Plan (Section 24.15). Mitigation for direct habitat loss and alteration on waterbirds will include, but is not limited to:

- avoidance of important habitat where practical alternatives are available (e.g. habitat loss and alteration was minimized through Project design);
- no destruction or disruption of active waterbird nests during site clearing during Construction and Operation; and
- re-vegetation of some reclaimed components during Decommissioning and Reclamation.

13.7.20.2 Mitigation for Sensory Disturbance

Mitigation measures for sensory disturbance on all wildlife are discussed in the Wildlife Management Plan (Section 24.12). The effects of sensory disturbance to songbirds will be minimized by mitigating the effects noise (Section 24.3, Noise Management Plan). Guidelines will be followed to minimize the effects of noise on songbirds and other wildlife (Milko 1998a; BC MOE 2006a).

The following noise mitigation measures will be implemented and are not limited to:

- noise specifications will be considered when selecting equipment to purchase;
- vehicles will be maintained regularly;
- speed limits will be imposed for on-site Project roads;
- mufflers will be installed on vehicles and maintained;
- noise dampening measures will be applied where possible; and
- noise will be monitored periodically at various human and wildlife receptor locations, as part of the Noise Management Plan (Section 24.3) and mitigation strategies will be adjusted accordingly, if required. Noise monitoring locations will be at locations to enable confirmation of noise modelling and effects assessment.

13.7.20.3 Mitigation for Direct Mortality

The effects of direct mortality on all wildlife will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effect of direct mortality will largely be mitigated by the same mitigation measures for habitat loss (Section 13.7.12.1).

Specifically, the effect of direct mortality to waterbirds will be mitigated through the following measures:

- scheduling vegetation clearing activities outside of sensitive periods (e.g., breeding from April 1 to July 31), where feasible;
- avoidance of active waterbird nests by conducting clearing outside of breeding periods (April 1 to July 31) where possible; and
- if avoidance of clearing activities is not possible outside of the breeding period, pre-clearing surveys would be conducted for nests in suitable habitat and a buffer area established around nests.

13.7.20.4 Mitigation for Chemical Hazards

Detailed information regarding mitigation and management of chemical attractants to waterbirds and other wildlife VCs is described in detail in Section 24.12, Wildlife Management and Monitoring Plan. Specifically, the following mitigation measures outlined in the Wildlife Management and Monitoring Plan (Section 24.12) are relevant to mitigate the effects of chemical hazards on waterbirds:

- monitoring the quality of standing water in Project areas; and
- employing wildlife exclusion measures if wildlife are observed to be using contaminated water or hazardous liquids.

Mitigation measures to reduce the effects of chemicals to water quality will in turn reduce or mitigate the effects of chemicals of potential concern for waterbirds. Mitigation for the degradation of water quality is detailed in Chapter 8 (Assessment of Surface Water and Aquatic Resource Effects). Extensive mitigation and management of Project effects on surface water quality was included in the design for the proposed Project. Proposed mitigation strategies include measures to avoid, reduce, and monitor adverse effects to surface water quality.

Additional mitigation and management strategies that are applicable to the maintenance of surface water quality are available in the following EA Chapters:

- Chapter 6, Assessment of Air Quality Effects;
- Chapter 7, Assessment of Groundwater Effects;
- Chapter 11, assessment of Terrain Effects.

Additional mitigation and management measures relevant to surface water quality are provided in the following environmental monitoring and management plans:

- Section 24.2, Air Quality and Dust Control Management Plan;
- Section 24.4, Site Preparation and Soil Salvage Management Plan;
- Section 24.5, Erosion and Sediment control Management Plan;
- Section 24.6, Water Management Plan;
- Section 24.7, Metal Leaching and Acid Rock Drainage Management Plan;
- Section 24.8, Flocculent Management Plan;
- Section 24.10, Selenium Management Plan;
- Section 24.13, Waste Management Plan;
- Section 24.18, Spill Response Plan; and
- Section 3.9, Project Phase: Decommissioning and Reclamation.

13.7.21 Key Effects on Amphibians

Western toads were chosen as a representative amphibian species for the environmental assessment as they are provincially blue-listed in BC and listed on Schedule 1 of SARA. Western toads were assessed for potential Project related effects. Habitat loss and alteration, disruption of movement, direct mortality, attractants, and chemical hazards were considered for the effects assessment because those effects have the potential to create a residual effect on western toads. The effect of sensory disturbance and indirect mortality were scoped out of this assessment because they are effects determined to have no interaction with western toads.

Sensory disturbance is not considered a potential effect on western toads because the population within BC near Tumbler Ridge is considered a subpopulation of western toads known as the non-calling population (COSEWIC 2012a), which do not call to attract a mate and are therefore not sensitive to increased noise levels. Therefore, the effect of sensory disturbance on western toads was not assessed. Indirect mortality is not considered a potential effect for western toad or other amphibians. The primary source of indirect mortality identified for wildlife VCs in association with Project development is increased harvesting pressure, and amphibians, including western toad, are not hunted or trapped, thus populations of amphibians would not be affected by indirect mortality.

The potential residual effects considered in the assessment for western toads during Construction, Operation, Decommissioning and Reclamation, and Post Closure phases are summarized in Table 13.7-46, and described in Sections 13.7.21.1 to 13.7.21.5.

Table 13.7-46. Ranking Potential Effects on Amphibians

Project Components/ Physical Activities	Potential Effects on Amphibians					
	Habitat Loss and Alteration	Sensory Disturbance	Disruption of Movement	Direct and Indirect Mortality	Attractants	Chemical Hazards
Construction						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	L	O	L	L	O	L
Shaft Site	O	O	O	O	O	M
Decline Site	O	O	O	O	O	M
Traffic and Transportation	O	O	L	L	O	L
Operation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	O	L	O	L	L
Shaft Site	O	O	O	O	L	L
Decline Site	O	O	O	O	L	L
Secondary Shaft Site	L	O	O	O	O	O
Traffic and Transportation	O	O	L	L	O	O
Decommissioning and Reclamation						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	O	O	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	O	L	L	O	O
Post-Closure						
Underground Mine	-	-	-	-	-	-
Coal Processing Site	O	O	L	O	O	O
Shaft Site	O	O	O	O	O	O
Decline Site	O	O	O	O	O	O
Secondary Shaft Site	O	O	O	O	O	O
Traffic and Transportation	O	O	L	L	O	O

(-) *No spatial or temporal overlap.*

O *Spatial and temporal overlap, but no interaction anticipated; no further consideration warranted.*

L *Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; no monitoring required, no further consideration warranted.*

M *Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*

H *Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

13.7.21.1 Habitat Loss and Alteration

The assessment of habitat loss due to the Project focuses on suitable breeding habitat for western toads. This species is sensitive to habitat fragmentation resulting from resource extraction and road networks (COSEWIC 2012a).

Western Toad Habitat Requirements and Availability

Western toads require a variety of terrestrial and aquatic habitats to complete the different stages of their life cycle. Toads migrate over relatively long distances each spring (i.e., May through June) from their winter hibernation sites to aquatic breeding sites. Spring breeding requires aquatic sites such as ponds, lakes, quiet stream sides, and other wetland areas with shallow open water, an open tree canopy, and warm water. Eggs develop into tadpoles in ponds and toadlets emerge in late July or August and disperse into surrounding terrestrial areas to summer foraging and winter hibernation habitat.

To evaluate the potential effects of the proposed Project on western toad habitat the BEC system was used to identify suitable breeding habitat. Within the LSA, a detailed wetland classification was implemented using western toad observation data and wetland classes (Chapter 12, Assessment of Wetland Effects). Wetlands with records of western toad observations from baseline studies were ranked high. Moderate ranking wetlands were identified as potential western toad habitat based on a review of all wetlands with a component of shallow open water using the Purview GIS application. High- and moderate-ranking wetlands were considered suitable western toad breeding habitat. Within the RSA, wetlands identified by Terrestrial Resource Inventory Mapping were used to classify potential wetland habitat for western toads. As these wetlands were not reclassified using Purview to identify shallow open water most suitable for western toad breeding, this number is likely an overestimate of available suitable habitat.

Suitable breeding habitat was defined as moderate (i.e., potential presence of western toad) and high (i.e., if western toads were detected during baseline studies). A total of 159 ha of suitable breeding habitat was identified in the LSA (Figure 13.7-64). Within the RSA, a total of 3,052 ha of potential western toad breeding habitat was identified using the Terrestrial Resource Inventory Mapping wetlands classification.

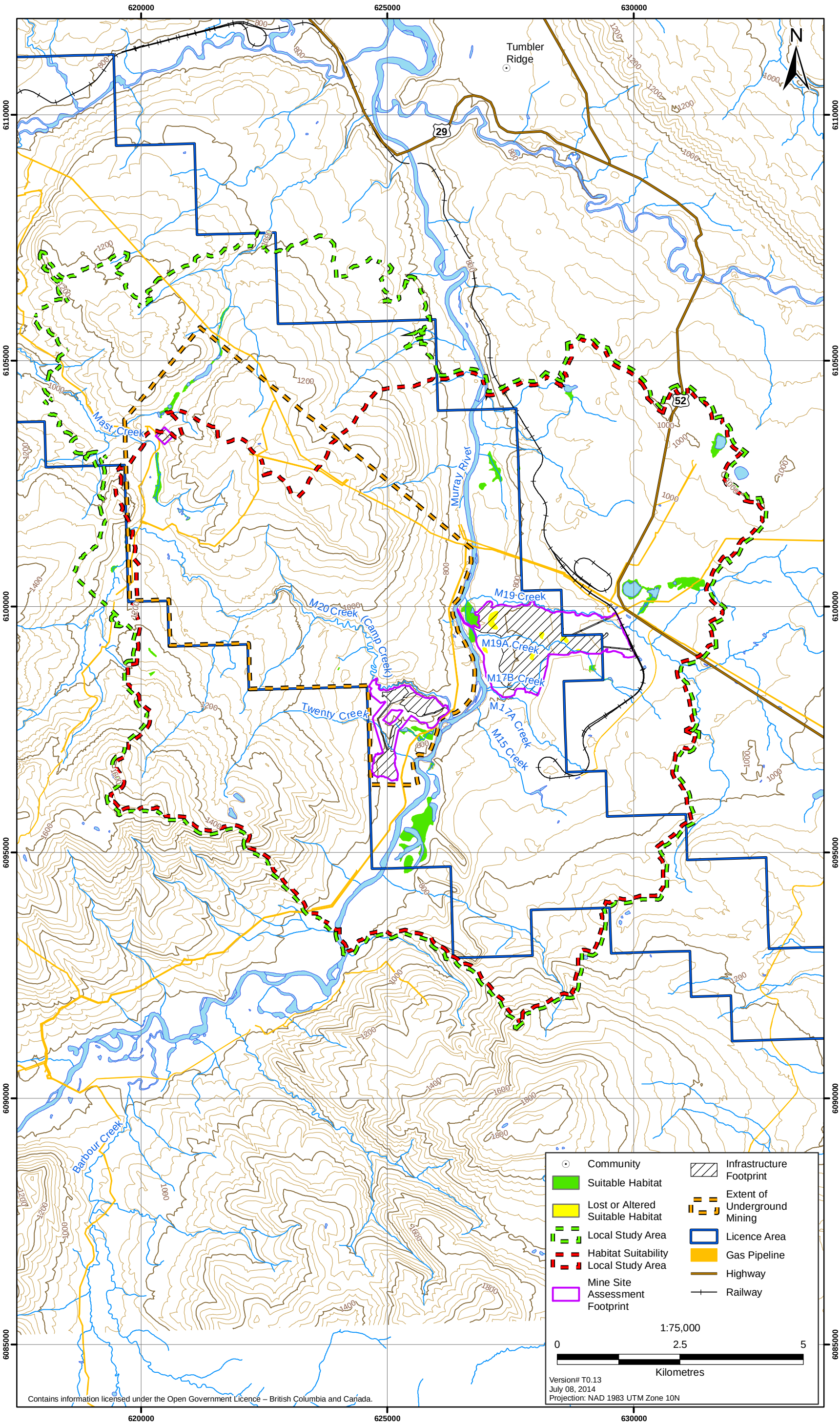
Habitat loss and alteration can occur as a result of clearing activities for the development of Project infrastructure within the Mine Site Assessment Footprints, degradation of wetlands due to the loss of hydrological function, dust inputs, seepage from seepage and sedimentation ponds (Section 12.7.1.2), and alterations to topography due of subsidence as a result of underground mining.

Terrestrial Habitat and Movement Corridors

Breeding habitat is critical to western toad; therefore, the focus of this assessment was to identify and characterize potential breeding sites. At least three breeding sites were confirmed in the LSA. Several others identified during aerial surveys were inaccessible by ground. Information on baseline surveys, habitat mapping, and potential effects and mitigation measures can be found in various sections of this assessment: 13.5.3.11, 13.5.4.12, 13.7.21, and 13.7.22.

Figure 13.7-64

Western Toad: Habitat Lost due to the Mine Site Assessment Footprint



Outside the breeding season, and as they disperse away from breeding ponds to terrestrial living habitats, western toads are habitat generalists, found in upland habitats typically within 2 km surrounding breeding ponds. The effects assessment ranked all wetlands within the LSA for their potential to support toad breeding using a combination of wetland mapping, aerial survey, and ground searches to inform the habitat rating. Both direct habitat removal and off-site habitat alteration due to the potential for altered hydrology and wetland function were evaluated.

Mitigation and management plans can be found in Section 24. Movements and habitat use by toads outside the breeding season are difficult to document. The primary barrier to toad movements is roads and other linear infrastructure. No new access roads are planned, and existing roads will be monitored for toad movements and mortality. A preference for monitoring will be conducted in areas that are most likely to represent toad migration corridors – draws and low areas adjacent to confirmed breeding sties. If movement events are located along existing roads, then appropriate mitigation will be conducted, which may include toad tunnels and/or drift fencing, depending on the site.

Terrestrial habitat has been quantified for various wildlife VCs, demonstrating minimal habitat loss. In addition, the construction of new roads and infrastructure are not planned near breeding sites. Combined with proposed monitoring and mitigation measures to ensure western toad movements across roads, potential effects on western toad due to terrestrial habitat loss or the creation of barriers to movements are not anticipated, and therefore not considered further in this assessment.

Habitat Loss and Alteration within the Mine Site Assessment Footprints

A total of 18 ha of Western toad habitat will be lost or altered due to the Project as a result of mine infrastructure development within the Mine Site Assessment Footprint during Construction and Operation (Table 13.7-47; Figure 13.7-64). This area lost represents 0.2% of the suitable western toad habitat available in the RSA and 8.3% in the LSA. The loss of suitable western toad habitat primarily occurs within the Coal Processing Site Mine Site Assessment Footprint.

Table 13.7-47. Suitable Western Toad Breeding Habitat Lost and Altered due to the Project Mine Site Assessment Footprint

		Regional Study Area		Local Study Area	
Season	Habitat Lost and Altered (ha)	Total Suitable Habitat (ha)	Suitable Habitat Lost/Altered (%)	Total Suitable Habitat (ha)	Suitable Habitat Lost/Altered (%)
Western Toad Breeding Habitat	18.0	3,052	0.2	159	8.3

Habitat Degradation Outside of the Mine Site Assessment Footprints

Western toad habitat degradation may occur as a result of wetland function degradation due to access road upgrade activities, and the construction of parking and laydown areas. As part of the Wetland Effects Assessment (Chapter 12), a risk-based approach using six components (hydrological connectivity, fragmentation, edge effect, dust, sedimentation and water quality, and invasive species) was employed to assess the probability (low to high) of damage to wetland functions for the Project (Section 12.8). Wetland characteristics used to evaluate western toad habitat functions and use were

based on wildlife baseline identification of western toad preference by wetland class (Section 12.8) and probability ratings based on the six components were ranked and summed in these habitats.

The wetland risk-based approach analysis (Chapter 12, Assessment of Potential Wetland Effects) identified approximately 30.5 ha of suitable western toad breeding habitat that will be at risk of degradation, of which 11.8 ha will be of low risk and 11.8 ha will be of moderate risk of degradation (Table 13.7-48). These wetlands occur next to the Murray River west of the Coal Processing Site and southeast of the Shaft and Decline Site, and east of Highway 52 (Figure 13.7-65).

Table 13.7-48. Western Toad Habitat Degradation Outside of the Mine Site Assessment Footprint

		Regional Study Area		Local Study Area	
Probability of Wetland Degradation	Area of Degradation (ha)	Suitable Habitat Available (ha)	Suitable Habitat Degraded (%)	Suitable Habitat Available (ha)	Suitable Habitat Degraded (%)
Low	18.8		0.6		11.8
Moderate	11.8		0.4		7.4
High	0.0		0.0		0.0
Total	30.5	3,052	1.0	159	19.2

Habitat Loss or Alteration due to Subsidence

After accounting for habitat lost due to the Mine Site Assessment Footprint, an additional 17.4 ha of suitable western toad breeding habitat (0.6% of total suitable habitat available in the RSA, and 10.9% of that available in the LSA) may be potentially be altered due to subsidence (Table 13.7-49). Figure 13.7-66 illustrates the total suitable western toad breeding habitat that may be altered within 200 m buffer zone of the coal seam panels where the effect of subsidence is anticipated to occur. The relative risk of change to suitable western toad breeding habitat is depicted by the number of overlapping panels to be mined, based on the Project Description (Section 3.6), where suitable western toad breeding habitat occurs (Table 13.7-49; Figure 13.7-66).

Table 13.7-49. Suitable Western Toad Breeding Habitat Potentially Altered due to Subsidence

		Regional Study Area		Local Study Area	
Number of Panels Mined Vertically	Area of Suitable Habitat Potentially Altered (ha)	Total Suitable Habitat (ha)	Suitable Habitat Altered (%)	Total Suitable Habitat (ha)	Suitable Habitat Altered (%)
Western Toad Breeding Habitat					
1	0.0				
2	7.7				
3	7.2				
4	0.0				
5	0.0				
Total	17.4	3,052	0.6	159	10.9

Figure 13.7-65

Predicted Degradation of Western Toad Wetland Habitat as a Result of Project Activities

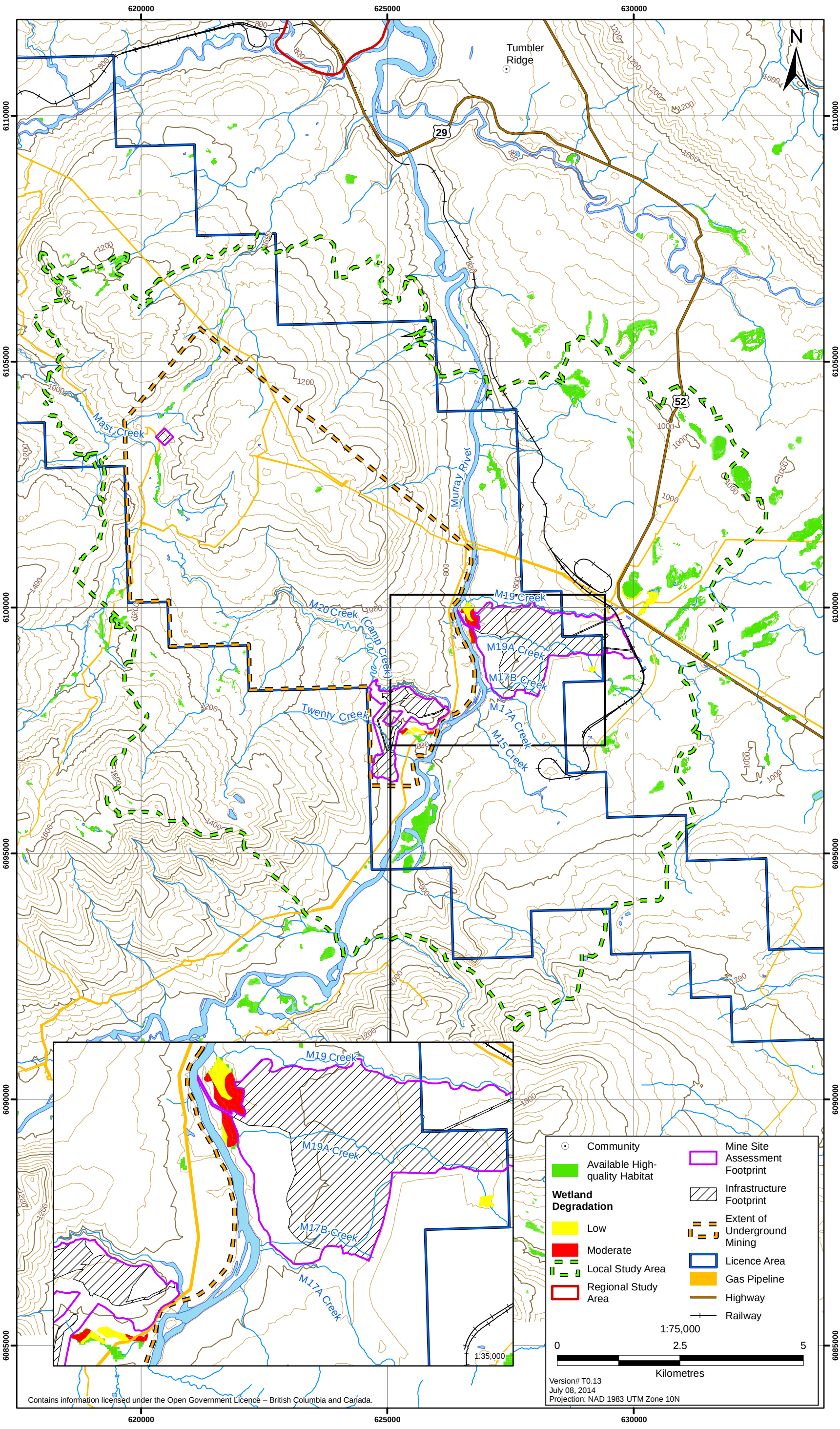
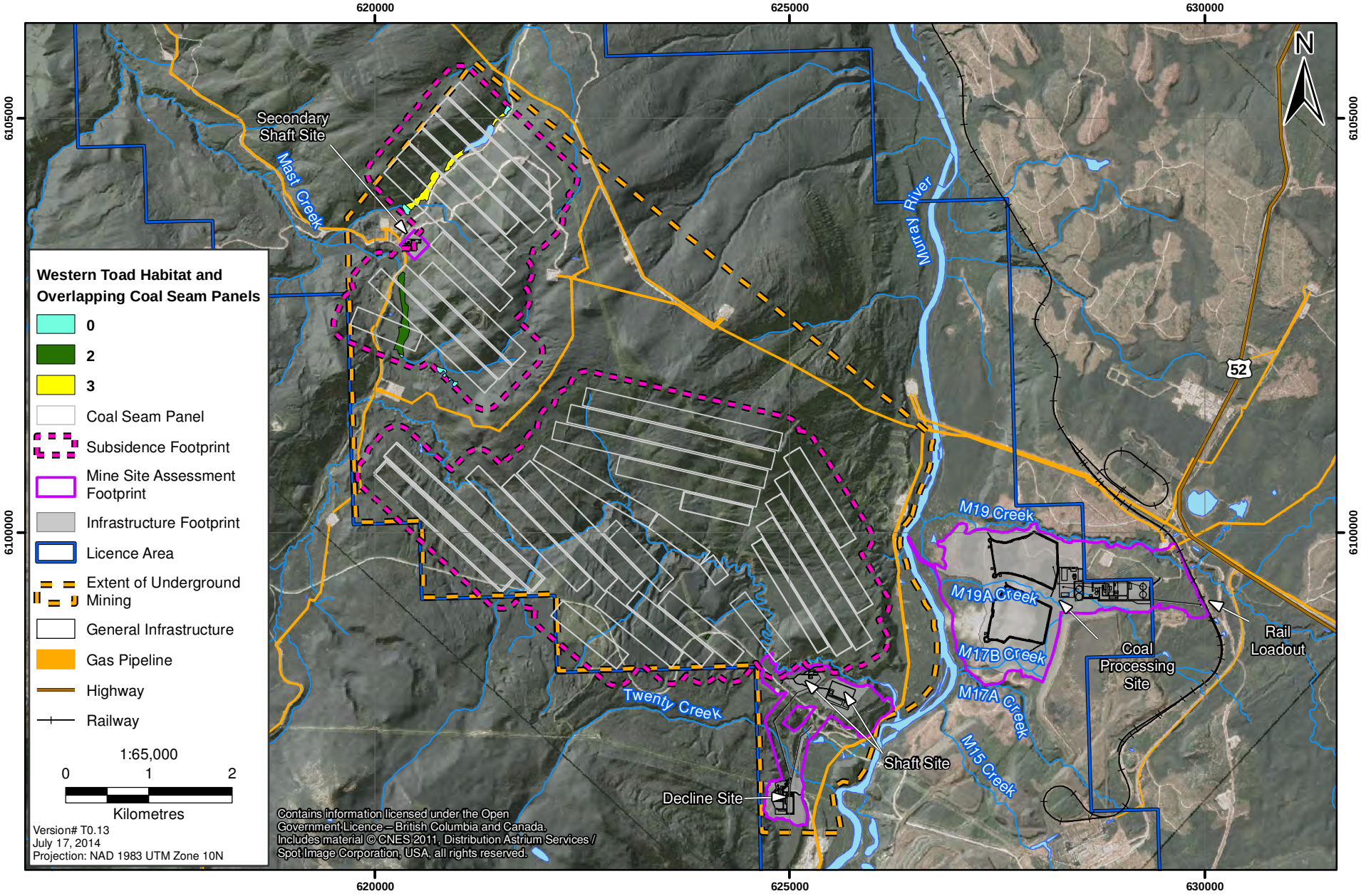


Figure 13.7-66
Suitable Western Toad Habitat and Number of Overlapping Coal Seam Panels



It is unclear how breeding habitat quality for western toad will change within the zone of subsidence, and additional suitable breeding habitat may be created as a result of the effects of subsidence on the terrain or, not all of the breeding habitat currently available may be lost or altered as a result of subsidence. Thus, the assessment assumes a worst-case scenario whereby calculations are based only on suitable western toad habitat that may be lost as a result of subsidence, but this is potentially an overestimate of actual habitat loss or alteration.

Residual Effects of Habitat Loss and Alteration for Amphibians

The effect of habitat loss and alteration is not predicted to result in a residual effect for western toad. Western toad habitat loss and alteration will occur within the RSA and LSA; however, the loss of habitat due to the Mine Site Assessment Footprint is minimal (0.2% of the suitable habitat within the RSA). A total of 30.5 ha of suitable wetland habitat (1.0% of the suitable habitat for western toad in the RSA) is also anticipated be degraded outside of the Mine Site Assessment Footprint due to Project activities that could influence sedimentation and runoff, hydrological connectivity, fragmentation, edge effects, dust, water quality, and invasive species in these areas. Subsidence may alter up to approximately 17.5 ha of additional suitable breeding habitat for western toad (0.6% of the suitable habitat available in the RSA). However, the direct and indirect effect of subsidence on wetlands used by western toad for breeding is likely overestimated and it is possible that some suitable habitat could be created. Thus, the total habitat loss and alteration is anticipated to be less than 1.8% of the available suitable western toad breeding habitat in the RSA, with the possibility of some habitat creation in the area of subsidence. It is anticipated that this loss of habitat will not result in a decrease to carrying capacity of the regional population of western toad and the disruption will be temporary, and possibly beneficial in some areas.

Mitigation measures include special management practices in riparian areas surrounding wetlands. Additional mitigation includes avoiding sensitive habitats (e.g. wetlands) where practical, and avoiding active western toad breeding sites by conducting clearing outside breeding periods (May 1 to August 31) or through pre-construction surveys for active western toad breeding ponds in suitable habitat when clearing is required within the breeding period. If active western toad breeding sites are found during the pre-construction surveys, adaptive mitigation measures would be in place to ensure no mortality of western toad (Direct Mortality; Section 13.7.21.2). With mitigation, no residual effect is anticipated for loss or alteration of western toad habitat.

13.7.21.2 Disruption of Movement

Western toads use terrestrial habitats for most of the year (Bartelt and Peterson 1994) but return to aquatic habitats to breed. Toads migrate over relatively long distances each spring (May to June) from their winter hibernation sites to aquatic breeding sites, and then to forested foraging areas during the summer. Eggs develop to tadpoles and toadlets in ponds, then toadlets emerge in late July or August and disperse into surrounding terrestrial areas. Toads are capable of moving over 5 km to breeding sites (T. M. Davis 2002). Females typically move farther away from breeding sites because they tend to breed once every two years, while males remain closer to breeding sites as they breed annually (Muths 2003).

Several wetlands close to the access road (Highway 52) and the section of the railway leading to the onsite railway loadout station were identified as suitable breeding habitat for western toads (Figure 13.7-64). Mitigation measures to reduce the effects of disruption of movement for western toads are listed in Section 13.7.22.2.

Residual Effects of Disruption of Movement for Amphibians

The effect of disruption of movement on western toads is not predicted to result in a residual effect. Monitoring is proposed to identify locations along the site and access roads within the Mine Site Assessment Footprints and the LSA where there is a high probability of bisecting toad movement corridors between terrestrial and aquatic habitats. Where corridors are identified, access road construction will incorporate provisions such as specialized toad tunnels or amphibian culverts under the road to facilitate movement (Section 24.12, Wildlife Management and Monitoring Plan). Monitoring for western toad mortality along the road (Section 13.7.22.3) will also form a component of the Wildlife Management and Monitoring Plan (Section 24.12). After mitigation, no residual effect on western toad movement is anticipated.

13.7.21.3 Direct Mortality

The potential sources of western toad direct mortality in association with the Project will be mortality resulting from heavy machinery use for vegetation clearing activities in western toad terrestrial and aquatic habitat primarily during Construction, and from collisions with vehicles during Construction and Operation.

Direct mortality could occur due to impacts from heavy machinery involved in Project-related construction. Toads utilize a variety of terrestrial habitats including all forest and woodland types (Section 13.7.21.1). If Construction is occurring during the breeding season, it may also affect toad breeding ponds due to sedimentation. Mitigation measures to reduce the effects of direct mortality of amphibians due to vegetation clearing activities are listed in Section 13.7.22.3.

The greatest concern for western toad populations during Construction and Operation will be direct mortality and injury of adults and newly emerged terrestrial juveniles near roads close to wetlands during the spring and late summer. Both high- and low-traffic roads can cause mortality, particularly during breeding migrations to and from breeding ponds from upland terrestrial habitat (Lesbarrères, Lodé, and Merilä 2004). Western toads will disperse more than 600 m from breeding sites (Rittenhouse and Semlitsch 2007). Suitable toad breeding habitat was identified along the eastern side of the LSA adjacent to Highway 52, and the section of the railway leading to the onsite railway loadout station; therefore, with additional use of this highway and rail line as a result of Project-related activities, there is potential for direct mortality to toads and toadlets moving from breeding sites to upland areas. Toads are terrestrial animals and prefer open, sunny areas to dense forests. Hence, toads are also at risk of vehicle—toad collisions when sunning themselves on roads, crossing roads to access breeding ponds, or during mass migrations of toadlets from breeding ponds to terrestrial summer and winter habitat. Mitigation measures to reduce the effects of direct mortality of western toads and other amphibians due to vehicle collisions are listed in Section 13.7.22.3.

Residual Effects of Direct Mortality for Amphibians

The effect of vegetation clearing is not predicted to result in a residual effect of direct mortality on western toads. Mitigation measures include special management practices in riparian areas surrounding wetlands, such as hand felling of trees, siltation control when working in riparian areas, and avoiding alteration of wetland conditions by limiting machinery use in these areas. Pre-clearing surveys will be conducted on any ponds that are identified as being affected by construction during the breeding (May) and emergence periods (mid-July to mid-August) to identify western toad breeding ponds. Use of machinery and associated Construction phase activities (i.e., tree felling) would be avoided in identified breeding ponds during those periods. Mitigation measures for non-riparian areas can include on-the-ground surveys prior to vegetation removal that can be carried out in concert with migratory songbird surveys.

The effect of direct mortality due to vehicle traffic collisions are not predicted to result in a residual effect on western toads. No additional access roads will be created as a result of the project. Mitigation measures to mitigate the effects of direct mortality to toads (Section 13.7.22.3 and detailed in Section 24.12, Wildlife Management Plan) include designing site road ditches and culverts to minimize pooling of water. Roadside pools that are formed will be monitored for toad breeding activities; and collisions between Project vehicles and wildlife will be documented and will include information on the location of the collision along Project roads and the highways.

With mitigation, no residual effects of direct mortality to western toad are anticipated.

13.7.21.4 Attractants

Western toads utilize a variety of natural wetland areas for breeding, as well as man-made structures such as ditches and road ruts (Gyug 1996; COSEWIC 2002a). These pools often have similar site characteristics to natural breeding ponds, including open forest canopy, warm water temperature, shallow water, and a gentle-sloped muddy bank. The use of these types of temporary pools by toads is of concern for two reasons. Firstly, the water in seepage and sedimentation ponds or ditches and ruts next to roads may dry up before toads complete metamorphosing between tadpole and toadlet, which would result in mortality of tadpoles. Secondly, if the water quality is insufficient for survival or results in developmental deformities in tadpoles or toadlets they may become at risk of direct mortality due to chemical hazards (Section 13.7.21.5). In addition, if water in roadside ditches does persist for long enough, emerging toadlets are in the vicinity of Project roads and are thus at risk of mortality from vehicle traffic.

Residual Effects of Attractants for Amphibians

The effect of attractants on western toads is not predicted to result in a residual effect. To avoid the creation of roadside pools that attract toads, the Project will construct drainage ditches that will promote free drainage (Section 13.7.22.4; and detailed in Section 24.12). While seepage and sedimentation ponds will be created for the Project, these ponds will be monitored for use by western toad (Section 13.7.22.4; and detailed in Section 24.12, Wildlife Management Plan). If western

toad are found using these ponds and these ponds are deemed a chemical hazard for toads (Section 13.7.21.5), adaptive mitigation measures would be implemented such as toad salvage procedures and wildlife exclusion measures. After mitigation, no residual effects of attractants on western toad are expected.

13.7.21.5 Chemical Hazards

During Operation, water storage ponds are predicted to contain chemicals that will exceed the guidelines for wildlife species. Selenium is predicted to occur above wildlife guidelines, among others, and has been identified as a chemical of potential concern for amphibians (Section 13.6.3.6). The Project will be monitoring water quality in all Project ponds and if ponds contain chemicals above wildlife guidelines, appropriate mitigation will be applied to exclude amphibians, including western toad from these ponds. Exclusion and re-direction of western toads is practiced successfully at a variety of industrial sites using drift fences. Western toads are terrestrial animals, only entering ponds during the spring to breed, so measures such as drift fencing can effectively exclude western toad and prevent them from breeding in ponds (Section 13.7.20.4). At closure, the ponds will be reclaimed, so no long term effects are predicted. Hence, no residual effects due to chemical hazards in water storage ponds are predicted for western toad for the Project.

Note that discharge from the Project into M19A creek was also predicted to contain concentrations of selenium above wildlife guidelines during the winter. Western toads are not present during the winter in waterbodies, since they are hibernating in upland locations and so will not be exposed to selenium in M19A creek. Exposure due to this route was scoped out of the assessment in Section 13.6.3.6.

13.7.22 Mitigation Measures for Amphibians

The Wildlife Management Plan (Section 24.12) describe the mitigation and management activities that are designed to reduce or eliminate potential effects to wildlife. Mitigation measures specific to amphibians are described in the following sections.

13.7.22.1 Mitigation for Habitat Loss

The effects of habitat loss and alteration on all wildlife, including amphibians will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). Additional mitigation measures for habitat loss and alteration are detailed in Decommissioning and Reclamation (Section 3.9). The potential effects of subsidence will be monitored as per the Subsidence Management Plan (Section 24.15). Mitigation for direct habitat loss and alteration on amphibians will include, but is not limited to:

- avoidance of important habitat where practicable alternatives are available (e.g., habitat loss and alteration was minimized through Project design); and
- reclamation of some wetland components during Decommissioning and Reclamation.

13.7.22.2 Mitigation for Disruption of Movement

The effects of disruption to movement on all wildlife will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effect of disruption of movement will largely be mitigated by the same mitigation measures for habitat loss (Section 13.7.22.1) and direct mortality (Section 13.7.22.3). Additional mitigation measures for the disruption of movements for western toad and other amphibians will include but are not limited to:

- minimizing human activity in identified high-quality wildlife habitats and movement corridors;
- creating and maintaining Project road culverts to facilitate wildlife movement/habitat connectivity if deemed necessary; and
- roadside pools that are formed will be monitored for toad breeding activities within the LSA.

13.7.22.3 Mitigation for Direct Mortality

The effects of direct mortality on all wildlife will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effect of direct mortality will largely be mitigated by the same mitigation measures for habitat loss (Section 13.7.22.1) and disruption of movement (Section 13.7.12.2).

Specifically, the effect of direct mortality to amphibians will be mitigated through the following measures:

- scheduling vegetation clearing activities outside of sensitive periods (e.g., western toad breeding from May 1 to August 31 and fall toadlet dispersal from August 1 to October 31), where feasible, and conducting pre-clearing surveys before wetland clearing during the breeding season; and
- ditches and culverts along the Project roads will be designed to minimize pooling of water. Roadside pools that are formed will be monitored for toad breeding activities; and collisions between Project vehicles and wildlife will be documented and will include information on the location of the collision along Project roads and the highways.

13.7.22.4 Mitigation for Attractants

Detailed information regarding mitigation and management of attractants to amphibians and other wildlife VCs is described in detail in Section 24.12, Wildlife Management and Monitoring Plan. Mitigation of attractants typically takes a two-tiered approach. First, positive behavioural stimuli are removed, such as draining roadside ditches. Second, if wildlife are still attracted to the feature, then negative reinforcement is used to dissuade them from returning. The following mitigation measures are relevant to mitigate the effects of attractants on amphibians:

- avoiding the creation of roadside pools attractive to western toad;

- where creation of ponds is necessary (e.g. seepage and sedimentation ponds), monitoring and adaptive management of the use of man-made waterbodies by western toads for breeding habitat;
- monitoring the quality and use of standing water in Project areas, and
- employing wildlife exclusion measures if wildlife are observed to be using standing water pools that exceed water quality guidelines for wildlife.

13.7.22.5 Mitigation for Chemical Hazards

Detailed information regarding mitigation and management of chemical attractants to amphibians and other wildlife VCs is described in detail in Section 24.12, Wildlife Management and Monitoring Plan. Specifically, the following mitigation measures outlined in the Wildlife Management and Monitoring Plan (Section 24.12) are relevant to mitigate the effects of chemical hazards on amphibians:

- monitoring the quality of standing water in Project areas; and
- employing wildlife exclusion measures if wildlife are observed to be using contaminated water or hazardous liquids.

Mitigation measures to reduce the effects of chemicals to water quality will in turn reduce or mitigate the effects of chemicals of potential concern for amphibians. These measures are outlined below:

<u>Mitigation for Chemicals of Potential Concern in Water</u>

Mitigation for the degradation of water quality is detailed in Chapter 8 (Assessment of Surface Water and Aquatic Resource Effects). Extensive mitigation and management of Project effects on surface water quality was included in the design for the proposed Project. Proposed mitigation strategies include measures to avoid, reduce, and monitor adverse effects to surface water quality. Details of mitigation and management strategies relevant to the surface water quality are available in the following EA Chapters:

- Chapter 6, Assessment of Air Quality Effects;
- Chapter 7, Assessment of Groundwater Effects;
- Chapter 11, Assessment of Terrain Effects.

Additional mitigation and management measures relevant to surface water quality are provided in the following environmental monitoring and management plans:

- Section 24.2, Air Quality and Dust Control Management Plan;
- Section 24.4, Site Preparation and Soil Salvage Management Plan;
- Section 24.5, Erosion and Sediment control Management Plan;
- Section 24.6, Water Management Plan;

- Section 24.7, Metal Leaching and Acid Rock Drainage Management Plan;
- Section 24.8, Flocculent Management Plan;
- Section 24.10, Selenium Management Plan;
- Section 24.13, Waste Management Plan;
- Section 24.18, Spill Response Plan; and
- Section 3.9, Project Phase: Decommissioning and Reclamation.

13.8 RESIDUAL EFFECTS ON WILDLIFE AND WILDLIFE HABITAT

Two residual effects were identified (habitat loss and disruption of movement) for three wildlife VCs (moose, grizzly bear, and furbearers). These residual effects are summarized in Table 13.8-1.

Table 13.8-1. Summary of Residual Effects on Wildlife and Wildlife Habitat

Valued Component	Project Phase (timing of effect)	Project Component / Physical Activity	Description of Cause-Effect[1]	Description of Mitigation Measure(s)	Description of Residual Effect
Moose and Furbearers (Fisher)	Construction and Operation	Mine Site Assessment Footprint, Subsidence Area	Vegetation clearing in the Mine Site Assessment Footprints will cause habitat loss. Subsidence will cause habitat alteration.	Maintain known and potential mineral licks in a natural state and ensure ungulates have access to them during the season when they are most used. No destruction or disruption of areas that contain known wallows, particularly during the ungulate breeding season during site clearing in the construction phase and during Construction and Operation. Re-vegetation of some reclaimed components during Reclamation. Avoid clearing during fisher denning period and conduct pre-clearing surveys if clearing during this period.	Habitat loss and alteration
Moose, Grizzly Bear and Furbearers (Fisher)	Construction and Operation	Mine Site Assessment Footprint, Subsidence Area, Continuous Project Noise	Permanent loss, functional loss, and alteration of habitat within the Murray River Resource Management Zone may disrupt use of this movement corridor.	Since the Project access road (The Murray River FSR) crosses the forested area likely used as a movement corridor along the Murray River, wildlife will be given the right-of-way along access roads and the highway. Enforcement of speed limits along on-site Project roads. Avoid vegetation alteration in the block of forested area between the Project footprint and the Murray River such that it can be used as movement corridor by wildlife.	Disruption to movement

[1]"Cause-effect" refers to the relationship between the Project component/physical activity that is causing the change or effect in the condition of the VC.

13.9 CHARACTERIZING RESIDUAL EFFECTS, SIGNIFICANCE, LIKELIHOOD AND CONFIDENCE ON WILDLIFE AND WILDLIFE HABITAT

Several features of the Project are important for wildlife and influenced the outcome of the effects assessment for wildlife. The project is: 1) at low elevation in a valley adjacent to the Murray River, 2) has a relatively small footprint, and 3) occurs in the Murray River Resource Management Zone which is a movement corridor for low elevation wildlife.

As a consequence, the effects assessment predicted a residual effect of habitat loss and alteration for two species which preferentially use valley bottom habitats – moose and furbearers. A second residual effect of disruption of movement was predicted for wildlife species that are sensitive to crossing open areas and who are likely using the Murray River as a movement corridor – moose, grizzly bear and furbearers.

Species that occur at high elevation, such as caribou and mountain goats were not predicted to interact with the Project. Other wildlife VCs, such as bats, raptors, songbirds, waterbirds, and amphibians did not have any residual effects because the Project would remove a small area of habitat and each of these VCs have stable populations in the RSA.

Residual effects and VCs are carried forward to the cumulative effects assessment (Section 13.11) where the potential effects of past, present and future surrounding industrial projects, forestry and other land use activities is presented in Section 13.11.

The following sections assess the potential Project-related effects and significance on each of the three VCs experiencing residual effects. The assessment considered results of wildlife baseline studies (Appendix 13-A to 13-C), regional planning documents, and scientific literature. The duration and frequency of each potential effect was considered when determining the potential effects of greatest concern. For example, an effect that occurs continuously beyond the life of the Project is likely to be of greater concern than a short-term effect that is confined to a discrete time period (Table 13.9-1). Each section is subdivided according to the issues deemed to be of concern for that VC. Within each section, the extent and significance of both positive and adverse potential effects of the Project on wildlife VCs are predicted and discussed. A detailed description of the effects assessment methodology, logic, variables, and descriptors are in Chapter 5.

Table 13.9-1. Definitions of Characterization Criteria for Residual Effects on Wildlife and Wildlife Habitat

Magnitude	Duration	Frequency	Geographic Extent	Reversibility	Ecological Context
Minor	Short-term	Once	Local	Reversible short-term	Low
Moderate	Medium–term	Sporadic	Landscape	Reversible medium-term	Neutral
Major	Long-term	Regular	Regional	Reversible long-term	High
	Far Future	Continuous	Beyond Regional	Permanent	

Once significance is determined, the probability (likelihood) of the residual effect occurring and the confidence in the significance predictions are made. The evaluation of likelihood and confidence for each residual effect is provided.

13.9.1 Residual Effects Characterization for Caribou

No residual effects are predicted for the Quintette caribou herd (Section 13.7.1). A comparison of high-quality caribou habitat from habitat suitability modelling with Project infrastructure, zone of subsidence, and noise models indicated that no project effects would interact spatially with the Quintette caribou herd. The Project and its effects are at low elevation, while caribou habitat was modelled as being at higher elevation than the Project.

13.9.2 Residual Effects Characterization for Moose

Two potential effects were rated as residual effects for moose: habitat loss and alteration and disruption of movement (Table 13.9-2). The significance of these potential effects is evaluated in the following sections.

13.9.2.1 Significance of Residual Effects of Habitat Loss and Alteration on Moose

The Project footprint, subsidence area and modelled noise will all occur at low elevation, which overlaps areas of moose habitat. High-quality habitat for moose that will be removed or altered during the life of the Project consists of riparian, wetland, and forested habitats. The total loss and/or alteration of 394 ha of combined winter and summer habitat, combined with an additional 561 ha potentially affected by subsidence, was deemed to result in an adverse residual effect for moose and is evaluated here for significance.

For this residual effect, the magnitude rating had a strong influence on the significance rating. The magnitude was rated as minor due to a relatively small habitat loss of 1.6% of the high-quality winter and summer habitat in the RSA, and an additional 2.3% affected by subsidence. The definition for minor magnitude in the assessment is: "differs from the average value for baseline conditions to a small degree (e.g., within the range of natural variation of the local population and well below a guideline or threshold value)."

The extent of the effect is local, as it is limited to the LSA. The duration is far future, because not all habitat will be reclaimed and it will take several decades for effective habitat to be produced in reclaimed areas. The frequency of the event leading to habitat loss (i.e., vegetation clearing) is sporadic; some habitat will be lost during Construction (394 ha), but an additional 561 ha may be altered due to subsidence during the Operation phase as underground mining progresses. Both the magnitude and the time for the terrain to settle are uncertain.

The effect is reversible as the majority of the project footprint will be suitable for reclamation post-closure. The resiliency of the moose population to disturbed and fragmented habitat is relatively high. The moose population in WMU 7-21 was stable between 1993 and 2006 (Rowe 2006); however, the population has not been surveyed since 2006 and the current status is unknown. The ecological context of the moose population is neutral – moose are common throughout BC.

Due to the minor rating for the magnitude of habitat removal and subsidence, the effect of habitat loss for moose is assessed as **not significant (minor)**.

13.9.2.2 Characterization of Likelihood and Confidence for Residual Effects Conclusions for Habitat Loss and Alteration on Moose

The probability of the effect occurring is high for the loss of habitat in the Mine Site Assessment Footprint, because vegetation will be cleared in this area during construction and operation. The probability of habitat effects in the subsidence zone is medium because habitat in this area may or may not be affected by subsidence. The confidence in the significance rating is medium due to uncertainty in habitat effects from subsidence. The area assessed as altered in the subsidence zone is likely an overestimate of the actual habitat area that is affected for moose. There is also uncertainty in the current moose population status, although it is assumed that the moose population is stable.

13.9.2.3 Significance of Residual Effects of Disruption to Movement on Moose

The distribution of infrastructure along Murray River was evaluated as a residual effect on the disruption of movement of moose north and south through the Murray River corridor. This effect will likely begin during the construction phase and continue during the operation phase. If subsidence in the subsidence area reduces moose habitat quality, then that may also reduce the ability of moose to move through the area. The Wolverine River corridor will be relatively unaffected by the Project, with the exception of rail traffic twice a day.

After mitigation, the residual effect of disruption of moose movements is expected to have a minor magnitude. The extent of this effect will be at the landscape scale because moose north and south of the LSA may be affected as they travel along the Murray River corridor.

The duration will be far future because it will take several decades for reclaimed areas to recover into useful moose habitat that will facilitate movement. The frequency will be sporadic, as movements by moose may only be disrupted when moose are travelling through the footprint. The effect will be reversible long term because of Post Closure reclamation of the Mine Site Assessment Area. The resiliency of the moose population to disturbed and fragmented habitat is relatively high. The ecological context of the moose population is neutral – moose are common throughout BC, but some populations in BC are known to be in.

The effect of disruption of moose movement is assessed as **not significant (minor)**.

13.9.2.4 Characterization of Likelihood and Confidence for Residual Effects Conclusions for Disruption to Movement on Moose

The likelihood that the Project will reduce the movement of moose along the river is medium – moose are known to avoid crossing open areas with human activity. The confidence that moose are using the Murray River as a movement corridor is low because it has been assumed that these valleys are movement corridors, but no movement data has been gathered in the field.

Table 13.9-2. Characterization of Residual Effects, Significance, Confidence and Likelihood on Moose

Residual Effect	Residual Effects Characterization Criteria							Significance of Adverse Residual Effects *Not significant (minor, moderate); Significant (major)*	Likelihood and Confidence	
	Magnitude (*minor, moderate, major*)	**Duration** (*short-term, medium-term, long-term, far future*)	**Frequency** (*once, sporadic, regular, continuous*)	**Geographic Extent** (*local, landscape, regional, beyond regional*)	**Reversibility** (*reversible short-term, reversible medium-term, reversible long-term, permanent*)	**Resiliency** (*low, neutral, high*)	**Context** (*low, neutral, high*)		**Probability** (*low, medium, high*)	**Confidence** (*low, medium, high*)
Habitat Loss and Alteration	Minor	Far Future	Sporadic	Local	Reversible Long-term	High	Neutral	Not Significant (minor)	High	Medium
Disruption of Movement	Minor	Far Future	Sporadic	Landscape	Reversible Long-term	High	Neutral	Not Significant (minor)	Medium	Low

13.9.3 Residual Effects Characterization for Mountain Goat

No residual effects are anticipated on mountain goat (Section 13.7.5).

13.9.4 Residual Effects Characterization for Elk

No residual effects are anticipated on elk (Section 13.7.8).

13.9.5 Residual Effects Characterization for Grizzly Bear

One potential Project effect was rated as a residual effect for grizzly bears – the effect of disruption of movement (Table 13.9-3).

13.9.5.1 Significance of Residual Effects of Disruption to Movement on Grizzly Bears

Roads and infrastructure may act as barriers to grizzly bear movements, reducing connectivity between seasonal habitats. Grizzly bears frequently alter their behaviour and avoid areas with human activity (such as high-use roads) and periods when humans are most active (Mueller 2001). Bears use a variety of habitats for movement, from riparian in the spring to alpine in the summer and fall. Since grizzly bear are more sensitive to human presence than other wildlife VCs, the potential for the Project to disrupt movement of bears along the Murray River was rated as a residual effect.

Since grizzly bear have very large home ranges and move across the landscape continuously and have a variety of habitats that they use for movement, including riparian, mid elevation and alpine, the magnitude of disruption of movement in the riparian areas of the Murray River was rated as minor. It is not expected that this effect will have local or regional population-scale effects.

The geographic extent of this effect will be local because the effect will be tied to the population of bears extending beyond the LSA. The duration will be long-term, i.e., for the life of the mine, as some features will be reclaimed and the subsidence area will retain natural features.

The frequency will be sporadic as grizzly bears encounter the mine site. The effect will be reversible in the long-term once the Project ends. Bears may temporarily avoid habitats where there is a barrier to their movement, but are expected to re-occupy the habitat once the disturbance is removed. The resiliency of grizzly bear populations to anthropogenic effects are generally considered to be low. Grizzly bears have low reproductive rates and are known to avoid industrial sites and so can have population-level effects in anthropogenically-modified landscapes. The context is moderate for grizzly bears due to uncertainty regarding the grizzly bear population in this region, but suitable habitat in the RSA is abundant. The effect of disruption to grizzly bear movement is assessed as **not significant (minor).**

13.9.5.2 Characterization of Likelihood and Confidence for Residual Effects Conclusions of Disruption of Movement on Grizzly Bear

The likelihood of this effect occurring is high for the Project footprint and medium for the subsidence area. The confidence is medium as it is unknown how subsidence may alter habitat suitable for grizzly bear.

13.9.6 Residual Effects Characterization for Furbearers

Two potential Project effects were rated as residual effects for furbearers, using fisher as a representative species (Table 13.9-4). These are habitat loss and alteration and disruption of movement.

13.9.6.1 Significance of Residual Effect of Habitat Loss and Alteration on Furbearers

Habitat use for furbearers, using fisher as a representative species, was mapped for the RSA as predominantly occurring in old growth forest at low elevations. Low elevation, old growth forests support fisher denning and structural complexity and cover for living requisites (e.g., hunting). The Project occurs at low elevation in the Murray River valley. Clearing for the Project will result in the loss of 304 ha of high-quality fisher habitat, while subsidence may result in up to 528 ha of habitat alteration for fisher. This combined area is equivalent to the home range size of a female fisher or half the home range size of a male fisher, and as a consequence was rated as a minor magnitude effect.

The duration will be far future as old growth forests will take decades to re-establish in reclaimed areas at closure and may take a similar time to recover should habitats be altered in the subsidence zone. However, effects on forested habitat in the subsidence zone are likely overestimated. The frequency is sporadic as habitat loss will occur once during vegetation clearing but habitat alteration due to subsidence may occur when coal panels have been mined.

The geographic extent is local as it will only occur within the LSA. Habitat loss is considered reversible in the long-term as reclaimed areas recover and any effects due to subsidence recover. The ecological context of fisher is neutral because even though the fisher is a provincially blue-listed species it is still sufficiently abundant to support a harvest. The resiliency of fisher populations is thought to be neutral. Fisher have intermediate reproductive rates, and are able to respond to some disturbance and habitat alteration due to human presence.

The Dawson Creek LRMP objective pertinent to fisher is to "manage critical habitat for furbearers (lynx, marten, fisher) to assist in sustaining viable, healthy furbearer populations" (BC ILMB 1999). The strategy associated with this objective is to "incorporate identified wildlife habitat features and known furbearer refuge areas into resource development, landscape unit level and operational planning processes to mitigate negative impacts to trapping and trapping improvements."

The effect of habitat loss and alteration on fisher is assessed as **not significant (minor)** because the loss and alteration of habitat equivalent to approximately one female fisher or half a male fisher's home range should still enable the remaining habitat in the RSA and trapline tenure areas to maintain trapping opportunities and regional fisher populations.

13.9.6.2 Characterization of Likelihood and Confidence for Residual Effect of Habitat Loss and Alteration Conclusions on Furbearers

The probability that the effect will occur is high in the mine footprint and medium for the subsidence zone since the effects on habitat due to subsidence may be variable. The confidence in the assessment is medium due to the uncertainty regarding subsidence, which is likely an overestimate of the magnitude and extent of the effect on fisher habitat.

Table 13.9-3. Characterization of Residual Effects, Significance, Confidence and Likelihood on Grizzly Bear

Residual Effect	Residual Effects Characterization Criteria							Significance of Adverse Residual Effects *Not significant (minor, moderate); Significant (major)*	Likelihood and Confidence	
	Magnitude (*minor, moderate, major*)	**Duration** (*short-term, medium-term, long-term, far future*)	**Frequency** (*once, sporadic, regular, continuous*)	**Geographic Extent** (*local, landscape, regional, beyond regional*)	**Reversibility** (*reversible short-term, reversible medium-term, reversible long-term, permanent*)	**Resiliency** (*low, neutral, high*)	**Context** (*low, neutral, high*)		**Probability** (*low, medium, high*)	**Confidence** (*low, medium, high*)
Disruption to Movement	Minor	Far Future	Sporadic	Local	Reversible Long-term	Low	Neutral	Not Significant (minor)	Medium	Medium

Table 13.9-4. Characterization of Residual Effects, Significance, Confidence and Likelihood on Fisher

Residual Effect	Residual Effects Characterization Criteria							Significance of Adverse Residual Effects *Not significant (minor, moderate); Significant (major)*	Likelihood and Confidence	
	Magnitude (*minor, moderate, major*)	**Duration** (*short-term, medium-term, long-term, far future*)	**Frequency** (*once, sporadic, regular, continuous*)	**Geographic Extent** (*local, landscape, regional, beyond regional*)	**Reversibility** (*reversible short-term, reversible medium-term, reversible long-term, permanent*)	**Resiliency** (*low, neutral, high*)	**Context** (*low, neutral, high*)		**Probability** (*low, medium, high*)	**Confidence** (*low, medium, high*)
Habitat Loss and Alteration	Minor	Far Future	Sporadic	Local	Reversible Long-term	Neutral	Neutral	Not Significant (minor)	High	Medium
Disruption to Movement	Minor	Far Future	Sporadic	Landscape	Reversible Long-term	Neutral	Neutral	Not Significant (minor)	Medium	Medium

13.9.6.3 Significance of Residual Effect of Disruption of Movement on Furbearers

Fisher use old growth forest for foraging and movement, and are likely using the Murray River valley as a movement corridor. The Project footprint will occur in the bottom of the Murray River valley and was assessed for potential to disrupt the movement of fishers along the valley floor. The Shaft Site on the west side of Murray River is planned to be built 405 m from the river (Figure 13.7-36). On the east side of Murray River in the Mine Site Assessment Footprint, the closest infrastructure will be the coarse coal reject piles that will be 450 m from the Murray River. The linear feature on the east side of the river that extends to the edge of the river will be a buried pipeline that will not interfere with movements after it has been placed underground. By using the full extent of the Mine Site Assessment Footprints it represents the worst case scenario for potential disruption of movement due to permanent loss and alteration, and functional loss of habitat; however, some riparian habitat is anticipated to remain undisturbed within the Mine Site Assessment Footprints that would continue to allow fisher and other wildlife movement through the Mine Site Assessment Footprints. Thus, the magnitude of the effect was assessed as minor.

The geographic extent was assessed as landscape, since disruption of movement may affect fisher outside of the LSA. The duration will be far future, since the removal of forested habitat will occur for the duration of the Project and will take several decades to re-establish after closure and reclamation. The frequency is sporadic as fisher encounter the Project as they move along the Murray River. The effect is reversible over the long term through reclamation activities. The ecological context of fisher is neutral since it is a species for which trapping is allowed. The effect of disruption to movement on fisher is therefore assessed as **not significant (minor)**.

13.9.6.4 Characterization of Likelihood and Confidence for Residual Effect of Disruption of Movement Conclusions on Furbearers

The likelihood of disruption of movement is rated as medium; although high-quality fisher habitat was modelled along the Murray River it is unknown how many fisher actually use the riparian corridor. The confidence in the assessment is medium as there is uncertainty regarding how many fisher use the area and how much of an impediment the infrastructure and associated Project noise will be to fisher in the riparian corridor.

13.9.7 Residual Effects Characterization for Bats

No residual effects are anticipated on bats (Section 13.7.13).

13.9.8 Residual Effects Characterization for Raptors

No residual effects are anticipated on raptors (Section 13.7.15).

13.9.9 Residual Effects Characterization for Songbirds

No residual effects are anticipated on songbirds (Section 13.7.17).

13.9.10 Residual Effects Characterization for Waterbirds

No residual effects are anticipated on waterbirds (Section 13.7.19).

13.9.11 Residual Effects Characterization for Amphibians

No residual effects are anticipated on amphibians (Section 13.7.21).

13.10 SUMMARY OF RESIDUAL EFFECTS ASSESSMENT AND SIGNIFICANCE FOR WILDLIFE AND WILDLIFE HABITAT

Table 13.10-1 summarizes the residual effects, mitigation strategies and significance on wildlife and wildlife habitat for the three wildlife VCs with residual effects: moose, fisher, and grizzly bear. None of the residual effects were rated as being significant due to the Project.

Table 13.10-1. Summary of Residual Effects, Mitigation, and Significance on Wildlife and Wildlife Habitat

Residual Effects	Project Phase	Mitigation Measures	Significance
Habitat Loss and Alteration			
Moose and Fisher	Construction and Operation	Maintain known and potential mineral licks in a natural state and ensure ungulates have access to them during the season when they are most used. No destruction or disruption of areas that contain known wallows, particularly during the ungulate breeding season. No destruction or disruption of active fisher or marten dens.	Not Significant (Minor)
Disruption to Movement			
Moose, Grizzly Bear, and Fisher	Construction and Operation	Since the Project access road (The Murray River FSR) crosses the forested area likely used as a movement corridor along the Murray River, wildlife will be given the right-of-way along access roads and the highway. Enforcement of speed limits along on-site Project roads. Avoid vegetation alteration in the block of forested area between the Project footprint and the Murray River such that it can be used as movement corridor by wildlife.	Not Significant (Minor)

13.11 CUMULATIVE EFFECTS ASSESSMENT

Cumulative effects are the result of a project-related effect interacting with the effects of other human actions (i.e., anthropogenic developments, projects, or activities) to produce a combined effect. Cumulative effects are assessed in each of the assessment chapters, as required by the BC EAO (2013a). A synthesis of these sections is provided as Chapter 21, to address CEA Agency (2013) requirements.

The method for assessing cumulative effects generally follows the same steps as the Project-specific effects assessment, as described in Sections 5.6 to 5.9: (1) scoping and identification of potential effects; (2) description of potential effects and mitigation measures, with subsequent identification of residual cumulative effects, and (3) identification and characterization of residual cumulative effects. However, because of the broader scope and greater uncertainties inherent in CEA (e.g., data limitations associated with some human actions, particularly future actions), there is greater dependency on qualitative methods and expert judgement. This framework for the CEA facilitates comparison between the two levels of assessment (project-specific and CEA) and between assessment categories, and is tailored to how much information is available.

13.11.1 Establishing the Scope of the Cumulative Effects Assessment

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

Residual effects carried forward from the Project-specific assessment are considered in combination with the residual effects of past, present, and future human actions, where some spatial and temporal overlap occurs. For wildlife and wildlife habitat VCs, cumulative effects can occur in the following ways:

- Nibbling loss – The gradual disturbance and loss of land and habitat. This occurs with removal of wildlife habitat from the landscape.
- Spatial and temporal crowding – Cumulative effects can occur when too much is happening within too small an area and in too brief a period of time. A threshold may be exceeded and the environment may not be able to recover to pre-disturbance conditions. This occurs with the fragmentation of habitat.
- Synergistic – Combined effects along a pathway that collectively result in an increased effect that may not have existed if the effect occurred in isolation.
- Additive – Combined effects along a pathway that equal the sum of the individual effects. For example, the multiple noise sources contributing to disturbance.

13.11.1.1 Spatial Boundaries

The RSA was selected as a suitable boundary to base the cumulative effects assessment on. It encompasses the regional setting for the Project and implicitly considers ecological factors, such as height of land in boundary delineation. The RSA also encompasses other relevant regionally important projects (Figure 11.12-1; Chapter 11, Terrestrial Ecology).

13.11.1.2 Temporal Boundaries

The temporal boundaries for the CEA go beyond the phases of the Project, beginning before major human actions were undertaken in the region, and extending into the future. While forecasting what human activity will occur at the end of the Project's post-closure phase is speculative, an extrapolation of a likely future development scenario for the next several decades—based on information available today—is attempted.

The following temporal periods are evaluated a part of the CEA:

- **Past:** 1940 (to capture the early non-Aboriginal human activities in the region) to 2010 (when baseline studies at the Murray River Project began);
- **Present:** 2010 (from the start of the Project baseline studies) to 2014 (completion of the environmental assessment); and
- **Future:** temporal boundaries are stated in each assessment chapter, and vary according to the time estimated for VCs to recover to baseline conditions (taking into account natural cycles of ecosystem change).

The other human actions considered in the CEA (described in Section 5.10.5; Chapter 5, Effects Assessment Methodology) fall into the following temporal categories:

- **Past** (closed) human actions;
- **Present** (continuing and active) human actions; and
- **Future** human actions, which may be:
  - **certain actions:** those actions that have received regulatory authorizations but are not as yet built or operating;
  - **reasonably foreseeable actions:** those actions that are currently in some stage of a regulatory authorization process, and for which a general concept is available from which potential cumulative effects may be anticipated; and
  - **hypothetical actions:** those actions that are conjectural but probable, based on best professional judgement of currently available information, including leases, licences, and extrapolations from historical development patterns; the potential cumulative effects of such actions are discussed on a conceptual basis only in this CEA.

13.11.1.3 Identification of Potential Cumulative Effects

Wildlife VCs and effects were scoped into the assessment in Section 13.6, and then assessed in Section 13.7 where each effect was evaluated for whether there would be a residual effect after standard mitigation and management activities. Residual effects are summarized in Section 13.8 and each residual effect is evaluated for their significance on VCs in Section 13.9 and summarized in Section 13.10. Residual effects were also carried forward to the cumulative effects assessment.

Two potential effects were identified with residual effects: (1) habitat loss and alteration for moose and fisher (as a proxy for furbearers), and (2) disruption of movement for moose, grizzly bear, and

fisher. These residual effects are predicted because the Project is situated in low elevation valley-bottom habitat, which is preferred by moose and fisher, and because the Project occurs in the Murray River corridor, a movement corridor for wildlife species. Grizzly bear were also included as a VC with residual effects due to disruption of movement because their movements are sensitive to human disturbance and infrastructure. The second residual effect (disruption of movement) is largely dependent on habitat loss and alteration, so rating human effects in relation to habitat loss is a robust approach for both residual effects.

A review of the interaction between potential residual effects of the Project and the residual effects of other projects and activities on wildlife and wildlife habitat VCs was conducted to determine the potential cumulative effects on the wildlife VCs of moose, grizzly bear and fisher (furbearers). A matrix identifying the potential cumulative effect interactions for wildlife VCs is provided in Table 13.11-1 of various past, present and future projects (Figure 13.11-1).

If there is no spatial and temporal overlap between the residual effects of the Project and those of another human action, the relevant cell is marked with a dash (-). Where there is spatial and temporal overlap, but no interaction is anticipated, the cell is marked with a grey box, and a rationale as to why no interaction is predicted is given in the table. If there is overlap, and an interaction is anticipated, the cell is marked with a green, yellow, or red box (these are summarized in the footnotes to Table 13.11-1).

Activities such as mining, road development and building communities have permanent or far-future effects on both the vegetation and the land structure in the RSA and were rated as having a moderate (M) effect. A moderate effect was defined as: Potential moderate adverse effects may require unique active management/ monitoring/ mitigation; warrants further consideration.

Activities such as forestry and seismic lines have an effect on vegetation and therefore habitat, but recover at the pace of vegetation succession and in most cases, there is little effect on the terrain, soils and physical capability of the landscape to support vegetation and therefore good wildlife habitat. These activities were therefore rated as having low (L) effects. A low effect was defined as: Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; no monitoring required, no further consideration warranted.

Since both temporary and permanent effects on vegetation and therefore habitat can affect wildlife habitat, both Low and Moderate effects in Table 13.11-1 are carried forward in the CEA.

An initial list of past, present, and future human actions to be considered in the CEA was developed as part of the Murray River Land Use Baseline Report via desk-based review of existing information and field research conducted between 2010 and 2014 (see Appendix 16-A; Non-traditional Land Use Baseline for a detailed description of this methodology). For the purposes of the CEA, this list was augmented with information on past historic mining operations retrieved from the BC Ministry of Energy, Mines, and Natural Gas, information on current and future hydroelectric projects from BC Hydro, FortisBC, and Columbia Power Corporation, and information on future actions from the BC EAO and the BC Ministry of Forests, Lands, and Natural Resource Operations (Table 13.11-2).

Table 13.11-1. Potential for Residual Effects to Interact Cumulatively with Effects of Other Human Actions on Wildlife and Wildlife Habitat

Timeframe		Name of Action	Dates Active	Proponent (if applicable)	Potential Cumulative Effect	Comments
Past	Historical	Hasler Coal Mine	1941 - 1945	Hasler Creek Coal Company	-	No spatial overlap with the RSA
		Sukunka (Bullmoose) Mine	1972 – 1975	BP Exploration Canada Ltd.	-	No spatial overlap with the RSA
	Recent	Bullmoose Mine	1983 – 2003	Teck Corporation	M	Small area of spatial overlap with the RSA
		Dillon Coal Mine	2004 – 2007	Walter Energy / Western Coal	-	No spatial overlap with the RSA
		Quintette (Babcock) Mine	1983 - 2000	Teck Corporation	M	Adjacent to the Murray River Project, across the river
		Quintette (MESA Pit) Mine	1983 - 2000	Teck Corporation	M	Adjacent to the Murray River Project, across the river
		Willow Creek Mine	2000 - 2013	Walter Energy	-	No spatial overlap with the RSA
		Major Forest Licensees			L	
		Roads/Gravel Pits			M	
		Oil and Gas Footprints			M	
		Oil and Gas Seismic Lines			L	
	Present	Brule Mine	2005 - 2016	Walter Energy	-	No spatial overlap with the RSA
		Trend Mine	2003 - 2016	Peace River Coal	M	
		Quality Wind Project	2013 - unknown	Capital Power	L	
		Peace Canyon Dam	1980 – unknown	BC Hydro	-	No spatial overlap with the RSA

(continued)

Table 13.11-1. Potential for Residual Effects to Interact Cumulatively with Effects of Other Human Actions on Wildlife and Wildlife Habitat (continued)

Timeframe		Name of Action	Dates Active	Proponent (if applicable)	Potential Cumulative Effect	Comments
Present (*cont'd*)		Wolverine Mine (Perry Creek) and EB Pit	2004 - 2016	Walter Energy	M	
		WAC Bennett Dam	1961 – unknown	BC Hydro	-	No spatial overlap with the RSA
		Major Forest Licensees			L	
		Roads/ Oil and Gas Footprints			M	
		Seismic Lines			L	
		Community of Tumbler Ridge			M	
		Tumbler Ridge Community Forest			L	
Future	Certain	Hermann Mine	2014 - 2025	Walter Energy	M	
		Quintette Mine	2013 - 2025	Teck Corporation	M	
		Roman Mine Project	2013 - 2024	Peace River Coal	M	
		Thunder Mountain Wind Park	2014 – unknown	Aeolis Wind	L	
		Tumbler Ridge Wind Project	2013 - unknown	Pattern Energy Group	L	
		Wartenbe Wind Project	2014 - unknown	Avro Wind Energy Inc.	-	No spatial overlap with the RSA

(continued)

Table 13.11-1. Potential for Residual Effects to Interact Cumulatively with Effects of Other Human Actions on Wildlife and Wildlife Habitat (continued)

Timeframe		Name of Action	Dates Active	Proponent (if applicable)	Potential Cumulative Effect	Comments
Future (*cont'd*)	Certain (*cont'd*)	Major Forest Licensees			L	
		Roads			M	
		Oil and Gas Footprints			M	
		Oil and Gas Sesimic Lines			M	
		Tumbler Ridge Community Forest			L	
	Reasonably Foreseeable	Echo Hill Mine	2015 - 2029	Hillsborough Resources Ltd.	-	No spatial overlap with the RSA
		Coastal Gaslink Project	2015 – 2048	TransCanada Pipelines	-	No spatial overlap with the RSA
		Horizon Mine	2015 - 2038	Peace River Coal	M	
		Meikle Wind Energy Project	2015 – 2041	Meikle Wind Energy Partnership	-	No spatial overlap with the RSA
		Northern Gateway Pipeline	2016 – 2068	Enbridge Northern Gateway Pipelines	M	
		Rocky Creek Energy Project	2015 – unknown	Rupert Peace Power Corporation	-	No spatial overlap with the RSA
		Site C Clean Energy Project	2015 – unknown	BC Hydro	-	No spatial overlap with the RSA
		Sukunka Coal Mine Project	2015 – 2038	Glencore	-	No spatial overlap with the RSA
		Sundance Wind Project	2015 - unknown	EDF Energies Nouvelles	-	No spatial overlap with the RSA
		Wildmare Wind Energy Project	2015 – unknown	Pattern Energy Group	-	No spatial overlap with the RSA

(continued)

Table 13.11-1. Potential for Residual Effects to Interact Cumulatively with Effects of Other Human Actions on Wildlife and Wildlife Habitat (completed)

Timeframe		Name of Action	Dates Active	Proponent (if applicable)	Potential Cumulative Effect	Comments
Future (*cont'd*)	Hypothetical	Babcock Creek Wind Project	Unknown	Babcock Ridge Wind Limited Partnership	L	
		Belcourt Saxon Coal Project	Unknown	Xstrata Coal Canada Ltd.	-	No spatial overlap with the RSA
		Huguenot Mine	Unknown	Colonial Coal International	-	No spatial overlap with the RSA
		Moose Lake Wind Power	Unknown	Moose Lake Wind Power Corporation	-	No spatial overlap with the RSA
		Septimus Creek Wind Power Project	Unknown	Zero Emission Energy Developments	-	No spatial overlap with the RSA
		Suska Mine	Unknown	Xstrata Coal Canada Ltd.	-	No spatial overlap with the RSA
		Wapiti River Coal Project	Unknown	Canadian Dehua International Mines Group Inc.	M	Small area of spatial overlap with the RSA

Notes:

- *No spatial or temporal overlap.*

O *No interaction anticipated.*

L *Negligible to minor adverse effect expected; implementation of best practices, standard mitigation and management measures; no monitoring required, no further consideration warranted.*

M *Potential moderate adverse effect requiring unique active management/monitoring/mitigation; warrants further consideration.*

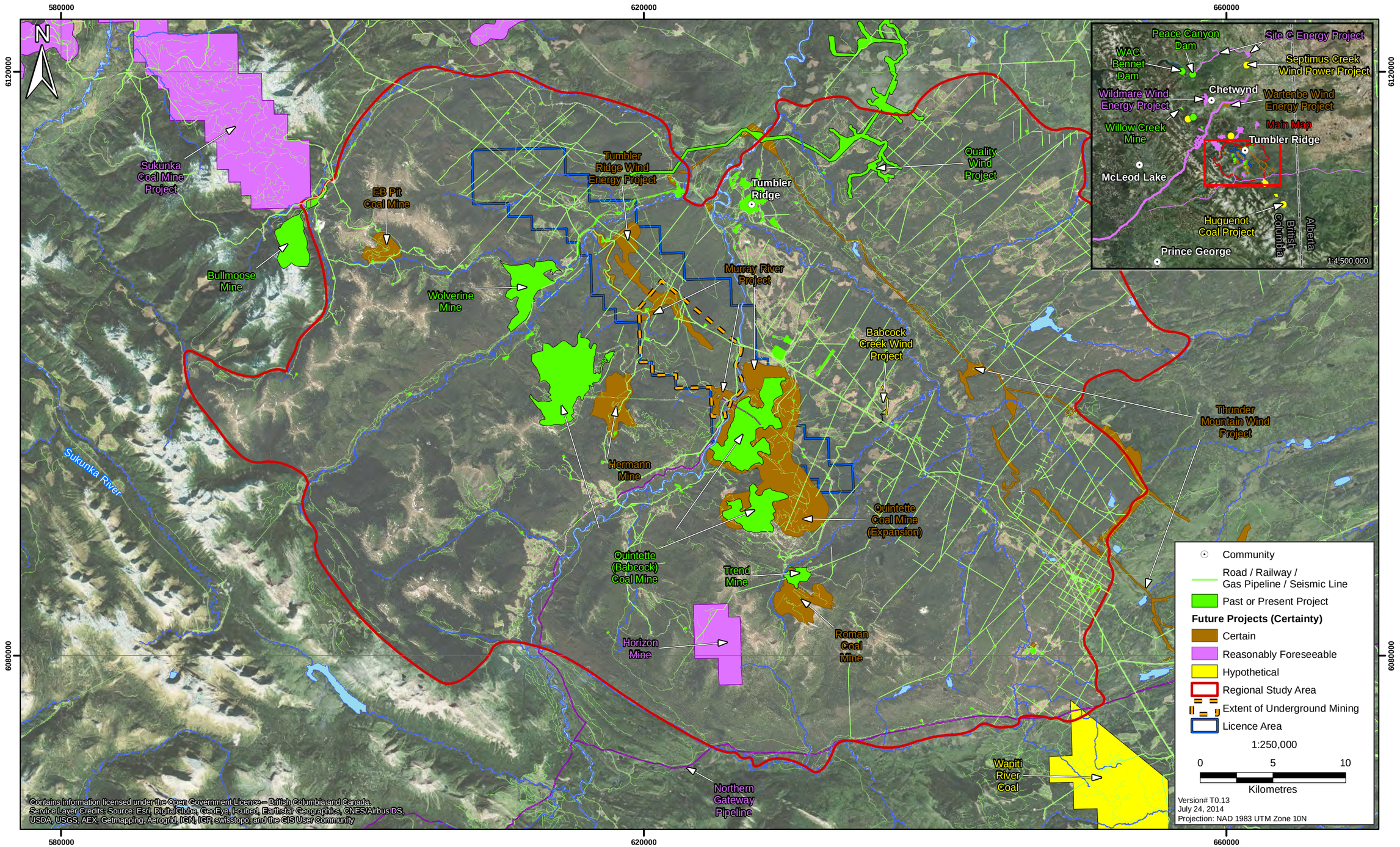
H *Key interaction resulting in potential significant major adverse effect or significant concern; warrants further consideration.*

Table 13.11-2. Timeframe, Industry and Projects Included in the Cumulative Effects Assessment for Wildlife.

Timeframe	Industry	Project
Past	Forestry	Various
Past	Mining	Bullmoose Mine
Past	Mining	Quintette Coal Mine
Past	Other infrastructure	Various, including Tumbler Ridge
Past	Seismic	Various
Past	Transportation networks	Various
Present	Forestry	Various
Present	Mining	Trend Mine
Present	Mining	Wolverine Mine
Present	Wind	Quality Wind Project
Future	Forestry	
Future	Mining	EB Pit Coal Mine
Future	Mining	Hermann Mine
Future	Mining	Horizon Mine
Future	Mining	Quintette Coal Mine
Future	Mining	Roman Coal Mine
Future	Murray River	Murray River - MSAF
Future	Murray River	Murray River - Subsidence
Future	Oil and Gas	Northern Gateway Pipeline
Future	Wind	Babcock Creek Wind Project
Future	Wind	Thunder Mountain Wind Project
Future	Wind	Tumbler Ridge Wind Energy Project
Future	Wind	Wapiti Wind Energy Project

Information was found to be deficient for many of the historic land uses in the RSA. To supplement the desk based information, interpretation of available spot satellite imagery was used to identify disturbance footprints in the RSA using ArcMap. While the imagery comes from multiple years (2005, 2008, and 2009) and has 250 cm pixel resolution, it was sufficient to provide a base from which to identify and delineate anthropogenic disturbances in the RSA. To avoid duplication of existing data, only disturbances that were not well recorded in available spatial datasets were delineated. Existing road shapes were used, although in some areas new roads were digitized as line features in ArcMap as they were not present in existing datasets. The majority of newly-digitized features were, in decreasing order, seismic lines, oil and gas roads and facilities, forestry roads, forestry cutblocks and the footprint of Tumbler Ridge.

Figure 13.11-1
Past Present and Future Project within the Cumulative Effects Assessment Regional Study Area



The main disturbance footprints digitized as polygons in ArcMap included the community of Tumbler Ridge, mine sites, gas wells (historic and currently active), seismic lines, gravel pits, airstrips, railways, pipelines, hydro lines and other disturbances that result in the removal or alteration of vegetation. Where existing data was available and accurate, these were used. Due to the relatively coarse scale of the imagery, some errors in attributing the cause of the disturbance may have occurred. Identifying differences between older gas well footprints and gravel pits was difficult to determine is some cases. This, however, does not affect the use of these data for determining cumulative anthropogenic impacts in the RSA; it only reduces the accuracy of determining the land use that resulted in the effect.

13.11.1.4 Analysis of Habitat Loss

A GIS analysis was used to model vegetation areas and wildlife habitat that has been lost due to disturbance. This analysis included potential Project-related residual effects in combination with residual effects from other past, present, or future projects or development activities in the CEA study area.

To account for existing loss of vegetation in the CEA study area, terrestrial ecosystems that would have been present in the absence of development were predicted using two modeling approaches. For small areas, a moving window approach was used and for larger areas, Biogeoclimatic Ecosystem Classification (BEC) zone distribution data from the RSA was used.

For the smaller areas, a moving window was used to fill the barren values in the PEM that were associated with anthropogenic footprints, including roads, wells, and other small footprints, or natural features, such as rock outcrops and other un-vegetated areas that would appear barren. All barren cells associated with infrastructure footprints (excluding barren cells in the alpine BEC zones) were set to 0 and removed. Then a raster calculator was used to create a 20 × 20 pixel moving window around each barren cell. The barren cell was replaced with the ecosystem type which occurs most frequently within the specified moving window. The window samples the raster cells adjacent to the barren cells and then populates them based on the neighbouring raster cells. As the barren raster cell footprints are small, this provides a reasonable approximation of ecosystems that would be present if the disturbance had not occurred. Large footprints associated with mines, development such as the community of Tumbler Ridge, or other infrastructure could not be modelled using the moving window method.

To fill larger areas without PEM data, the area of Biogeoclimatic Ecosystem Classification BEC subzones and variants within each anthropogenic footprint was calculated. Then the distribution of site series and forest structural stage, which refines the habitat identification, for each BEC unit in the RSA was calculated. Assuming the same distribution within the footprint as the RSA, these sites series and forest structural stages were assigned to the relevant BEC units within the footprints to approximate pre-disturbance ecosystem distributions. This then completed the modelling for the ecosystem distribution across the RSA, producing a new PEM layer. This new layer represents the ecosystems that would be present in the RSA if no development had occurred. This new PEM layer was then linked to finalized wildlife habitat ratings provided by EDI. Note that the figures representing habitat suitability without anthropogenic disturbance use a graphical method to fill in

the larger holes due to mining operations and are not meant as a physical representation of habitat distribution.

To calculate cumulative loss and alteration of wildlife habitat, an industrial disturbance layer was created representing all past, present and future disturbances across the RSA. Past projects and infrastructure from the 1940's to present day and future projects deemed either certain or reasonably foreseeable were considered in the analysis. A system of hierarchy was determined across time as well as disturbance type so that an area was never double-counted as a disturbance. Across time the hierarchy, from highest to lowest, was chronological, with past as dominant. Disturbance types were ranked as follows, again from highest to lowest: the Murray River project, industry (mines, wind projects, oil and gas), transportation networks, forestry cut-blocks, and seismic lines.

Buffers were added to anthropogenic features in the calculation of wildlife habitat loss in the following ways:

1. Wildlife habitat was considered lost when it overlapped with either industry footprints or transportation networks that were buffered by 10 meters.
2. Habitat was deemed altered when it overlapped with either forestry cut-blocks or seismic lines, which were buffered by 4 meters.
3. All industry footprints were buffered by 100 meters and this buffered area was considered altered.
4. Areas of subsidence associated with the Murray River project were buffered by 200 meters and were considered separately from altered and lost areas.

As a validation of the methods, the values produced by this analysis were comparable to those produced in the habitat suitability modeling used for the effects assessment. For example, the undisturbed area of moose winter habitat in the RSA was 19,964 ha, minus the area of habitat lost from historic activities (756 ha) is 19,208 ha. The area of high-quality moose habitat used in the effects assessment was 19,228 ha, which is less than 0.1% difference between the methods.

It should be noted that baseline studies used two different methodologies to conduct habitat suitability mapping in the LSA (Appendix 13-C) and the RSA (Appendix 13-B). The methods used in the LSA identify larger areas of high-quality habitat than those used in the RSA. The effects assessment used the modeling for the LSA to measure loss due to the Project. The cumulative effects assessment uses the modeling which is available for the entire RSA such that loses from all projects and activities can be compared. Due to the differences in mapping methods, the areas of high-quality habitat identified as lost due to the Project are not exactly the same in some cases in the effects assessment than those reported in the cumulative effects assessment. The cumulative effects assessment used the same methods to measure loss of high-quality habitat as those used to measure the availability of that habitat.

13.11.1.5 Analysis of Disruption of Movement

The Murray River Resource Management Zone (MRRMZ) was delineated in the Dawson Creek LRMP. The Murray River valley likely provides a movement corridor within the MRRMZ. In order

to determine the degree to which the Project would alter the ability of wildlife to move within the MRRMZ, the effects assessment evaluated the amount of high-quality habitat lost and altered due to potential subsidence and noise disturbance by the Project in the MRRMZ.

The cumulative effects assessment used a similar approach to determine effects on wildlife movement. The area of high quality habitat lost and altered due to past, present, Project and future projects was calculated for the MRRMZ using the same procedures and data as was used in the RSA (Section 13.11.1.4).

13.11.2 Cumulative Effects on Moose

The effects assessment identified two potential residual effects for moose; habitat loss and alteration and disruption of movement (Section 13.7.3). These potential effects were carried forward to the cumulative effects assessment and are evaluated for potential cumulative effects in the following sections.

13.11.2.1 Habitat Loss and Alteration

The distribution of moose habitats predicted to occur in the absence of anthropogenic disturbance was calculated using the methods described in Section 13.11.1.4 and displayed in Figure 13.11-2. The amount of high-quality late winter habitat available in the RSA and the habitat lost and altered by past, present and future activities was calculated and reported in Table 13.11-3. Late winter habitat was evaluated because it is considered a limiting resource for moose.

Of all activities past, present and future, the largest contributors to direct habitat loss are mining and transportation infrastructure, while forestry and wind energy projects are the primary industries altering moose habitat (Table 13.11-3). Overall, approximately 13.2% of high-quality winter habitat will be removed or altered if all future projects are undertaken (Figure 13.11-3).

Forestry activities and seismic lines make up approximately 20% of the total land area lost or altered in the RSA. Moose may benefit from these activities since they open the forest canopy and enable the growth of early-seral vegetation that moose prefer. This effect is transient over the intermediate term (~20 years) as habitat quality may diminish as a dense tree cover re-establishes. Therefore, to date, roughly half of the area affected by human activity has been beneficial to moose (cumulative altered at present = 626 ha), while 638 ha have been lost to human activities.

The Murray River Coal Project will include clearing approximately 32 ha of high-quality moose winter habitat. This makes up 3.3% of the area of high-quality winter habitat lost due to human disturbance in the RSA to date, and 20% of the area altered by human activities (including the area of subsidence).

If all projects go ahead in future, the cumulative area of high-quality winter habitat for moose will be 1,178 ha lost and 1,463 ha altered within the RSA, or 5.9% and 7.3% respectively. The effect of habitat loss and alteration on moose from all past, present and foreseeable future activities was therefore evaluated as a residual cumulative effect.

Table 13.11-3. Area of High-Quality Habitat Lost and Altered in the Past, Present and Future for Moose in the RSA

Time Period		Area of High-Quality Habitat Removed in the RSA (ha)								% of Total Lost and Altered	
		Past		Present		Murray River		Future			
Season		Winter	Growing	Winter	Growing	Winter	Growing	Winter	Growing	Winter	Growing
Total Without Disturbance		**19,964**	**21,137**								
Industry	**Effect**										
Forestry	Alteration	310	342	167	170			2	2	18.2	18.4
Seismic	Alteration	60	63	--	--			--	--	2.3	2.3
Mining	Loss	169	187	214	220	32	39	135	154	20.8	21.5
Mining	Alteration	37	40	24	32	15	19	23	23	3.7	4.1
Mining	Subsidence	--	--	--	--	130	137	--	--	4.9	4.9
Transportation	Loss	512	529	--	--			--	--	19.4	19
Wind	Alteration	--	--	94	96			401	408	18.7	18.1
Other Infrastructure	Loss	74	81	--	--			--	--	2.8	2.9
Oil and Gas	Lost	--	--	--	--			42	45	1.6	1.6
Oil and Gas	Alteration	--	--	--	--			200	204	7.6	7.3
Total Lost (ha)		756	797	213	220	32	39.4	177	198		
Total Altered (ha)		407	445	285	298	145	156.0	626	638		
% Lost		3.8	3.8	1.1	1.0	0.2	0.2	0.9	0.9		
% Altered		2.0	2.1	1.4	1.4	0.7	0.7	3.1	3.0		
Cumulative Area Lost (ha)		756	797	969	1,017	1,001	1,057	1,178	1,255		
Cumulative Area Altered (ha)		407	445	691	743	837	899	1,462	1,536		
Total Lost and Altered (ha)								**2,640**	**2,792**		
Cumulative % Lost		3.8	3.8	4.9	4.8	5.0	5.0	5.9	5.9		
Cumulative % Altered		2.0	2.1	3.5	3.5	4.2	4.3	7.3	7.3		

" – " Indicates that no projects were identified with this effect in Table 13.11-1.

Figure 13.11-2

Moose: High-Quality Habitat in the Regional Study Area and Murray River Resource Management Zone in the Absence of Past and Present Effects

ERM

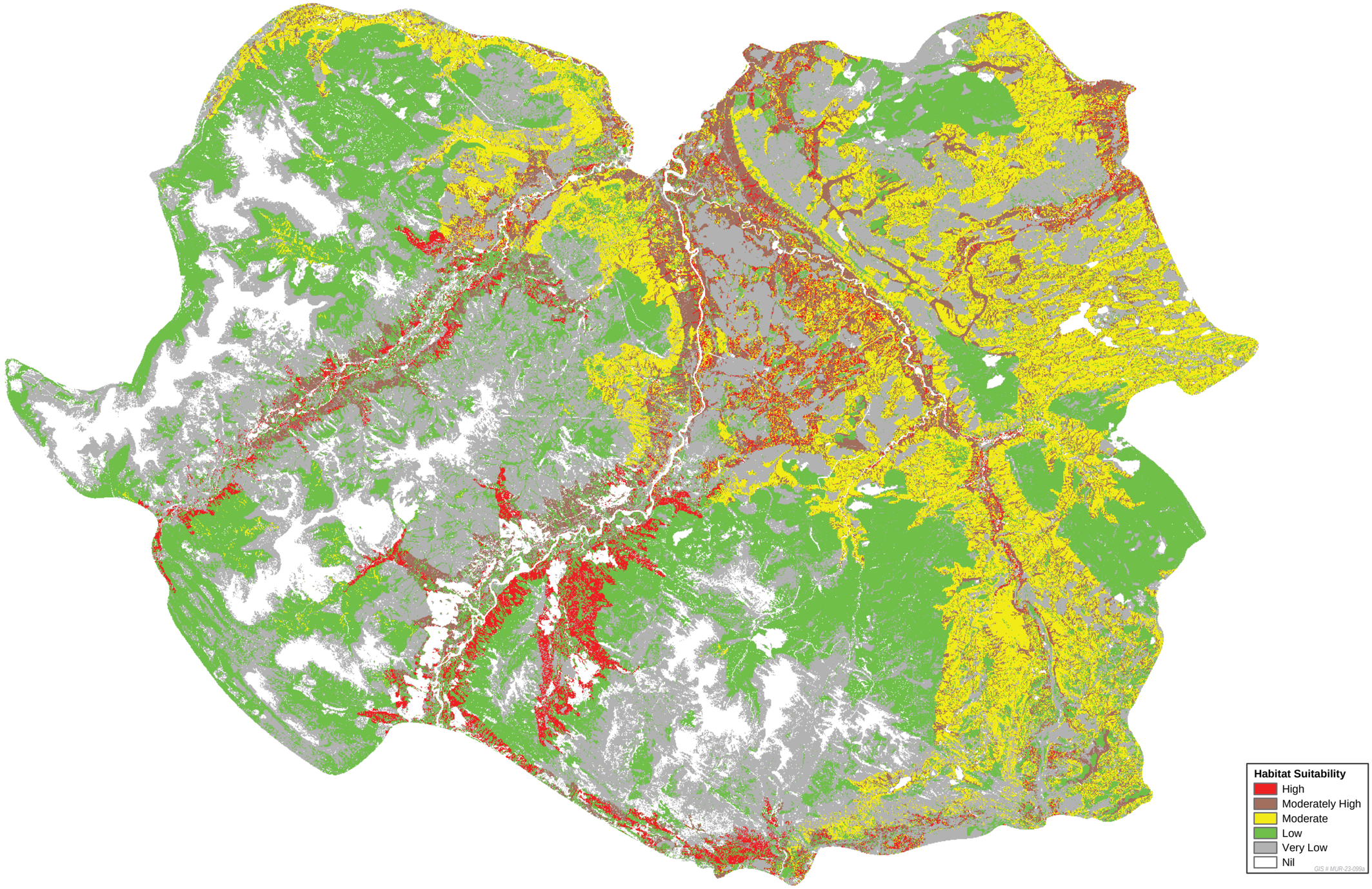
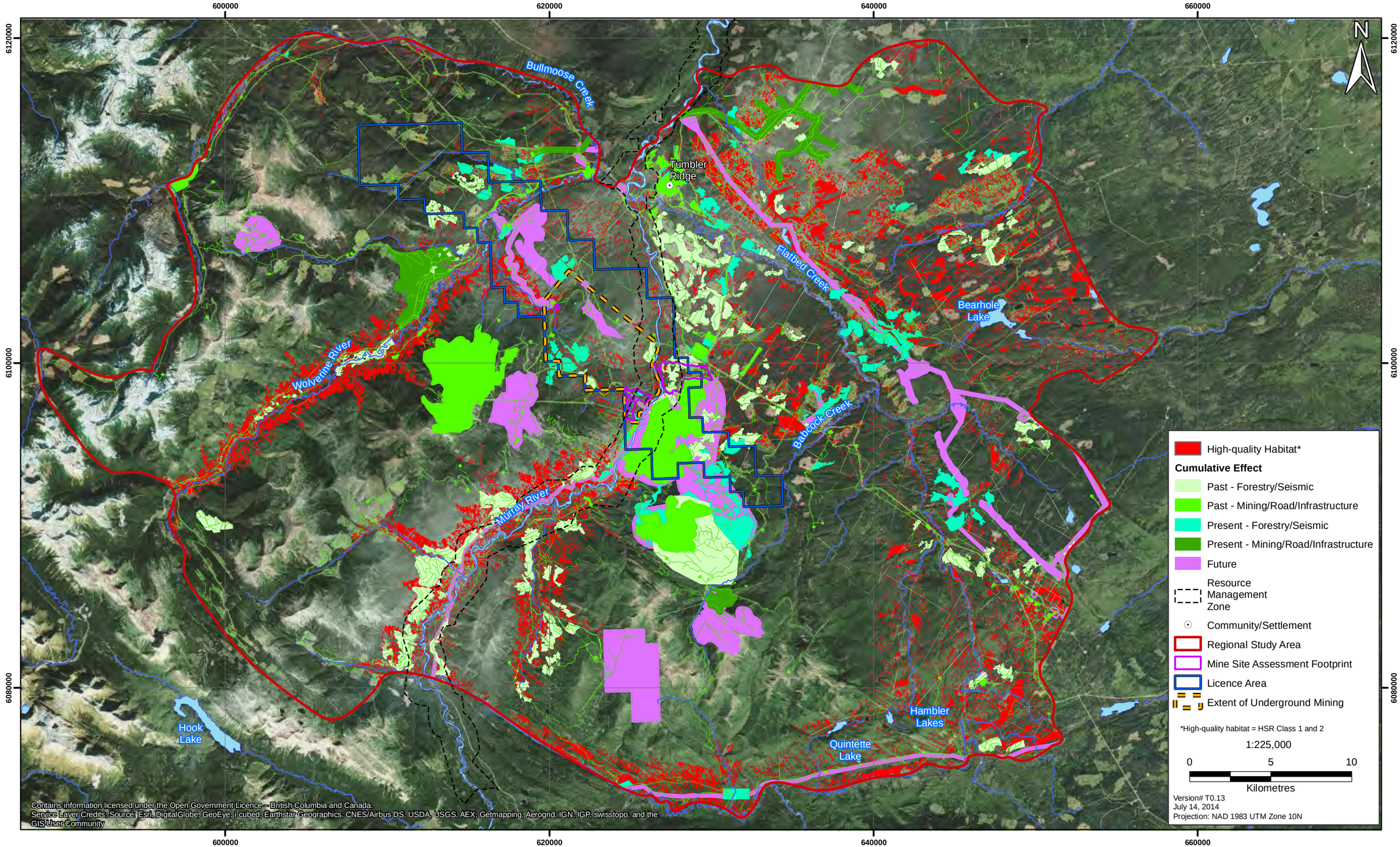


Figure 13.11-3
Moose: Cumulative Effects of Developments on Habitat in the Regional Study Area and Murray River Resource Management Zone



13.11.2.2 Disruption of Movement

The Murray River Resource Management Zone (MRRMZ) is a corridor along the Murray River that is likely used by moose as a movement corridor (Figure 13.11-3). Currently, approximately 10% of the high quality moose habitat in this corridor has been lost or altered due to human activities (Table 13.11-4). Transportation corridors, such as highways and forestry roads, and mining activity make up the majority of the lost habitat for moose, while forestry is the primary cause of habitat alteration. Forestry operations are occurring both north and south of the Project site in the MRRMZ.

Future projects include the Murray River Project, additional mining projects and oil and gas pipelines. The Murray River Project will remove 1.1% and alter 1.5% of additional high-quality moose habitat in the MRRMZ. Additional mining will contribute 0.6% of habitat loss, while oil and gas pipelines will remove ~0.2% of habitat and alter ~3% of habitat. If these projects advance as planned, the habitat loss and alteration will increase from approximately 5% lost and altered (each) to approximately 10% lost and 15% altered.

There is a concentration of activities along the Murray River on either side of the Murray River FSR bridge. These activities include the Murray River project on the east and west sides of the river and other mining operations on the east side of the river, combined with forestry operations north and south of the mining operations (Figure 13.11-3). On average, these projects leave a 400-500 m buffer between the project footprint and the Murray River, leaving a total of 1 km wide movement corridor along the Murray River.

This movement buffer along the Murray River will be susceptible to disturbance effects, such as vehicle noise and movement, facilities noise, and the presence of workers. As a consequence, the cumulative effect of disruption of movement in the MRRMZ is considered a residual effect for moose.

13.11.3 Cumulative Effects on Grizzly Bear

The effects assessment identified one potential residual effect for grizzly bear; disruption of movement (Section 13.7.9). This potential effect was carried forward to the cumulative effects assessment and is evaluated for potential cumulative effects in the following section.

13.11.3.1 Disruption of Movement

The distribution of grizzly bear habitats predicted to occur in the absence of disturbance was calculated for the RSA and MRRMZ using the methods described in Section 13.11.1.4 and is displayed in Figure 13.11-4. The amount of high-quality habitat available in the MRRMZ and the habitat lost and altered by past, present and future activities is reported in Table 13.11-5.

Grizzly bears use riparian areas during spring and follow the green-flush of vegetation uphill as the season progresses. Table 13.11-5 displays this trend, with the largest amount of high-quality habitat modelled for the spring (1,282 ha), which then declines for the summer (227 ha) and fall (328 ha). To date, approximately 11% of spring habitat has been removed by human activities, largely road corridors, and approximately 32% has been altered, principally by forestry (Figure 13.11-5). Depending on the age of the cut-block, habitat alteration by forestry can be a positive, neutral or negative effect on grizzly bear.

Table 13.11-4. Area of High-Quality Habitat Lost and Altered in the Past, Present and Future for Moose in the MRRMZ

Time Period		Area of High-Quality Habitat Removed in the Riparian Management Zone (ha)								% of Total Lost and Altered	
		Past		Present		Murray River		Future			
Season		Winter	Growing	Winter	Growing	Winter	Growing	Winter	Growing	Winter	Growing
Total Pre-Disturbance		**1,577**	**1,682**								
Industry	**Effect**										
Forestry	Alteration	56	74	18	19			--	--	19.4	21.0
Seismic	Alteration	--	--	--	--			--	--	0.0	0.0
Mining	Loss	33	37	--	--	17	24	32	47	21.8	24.5
Mining	Alteration	9	12	--	--	10	14	10	10	7.5	8.1
Mining	Subsidence	--	--	--	--	13	13	--	--	3.6	3.1
Transportation	Loss	47	53	--	--			--	--	12.5	12.0
Wind	Loss	--	--	0	0			--	--	0.0	0.0
Wind	Alteration	--	--	0	0			3	3	0.9	0.8
Infrastructure	Loss	9	10	--	--					2.3	2.2
Oil and Gas	Lost	--	--	--	--			16	18	4.3	4.0
Oil and Gas	Alteration	--	--	--	--			105	107	27.7	24.4
Total Lost (ha)		89	99	0	0	17	24	48	64		
Total Altered (ha)		65	86	18	19	23	27	118	120		
% Lost		5.7	5.9	0.0	0.0	1.1	1.5	3.1	3.8		
% Altered		4.1	5.1	1.1	1.1	1.5	1.6	7.5	7.1		
Cumulative Area Lost (ha)		89	99	89	99	106	124	155	188		
Cumulative Area Altered (ha)		65	86	83	105	106	132	224	252		
Total Lost and Altered (ha)								**379**	**440**		
Cumulative % Lost		5.7	5.9	5.7	5.9	6.7	7.3	9.8	11.2		
Cumulative % Altered		4.1	5.1	5.2	6.2	6.7	7.8	14.2	15.0		

" – " Indicates that no projects were identified with this effect in Table 13.11-1.

Figure 13.11-4

Grizzly Bear: High-Quality Habitat in the Regional Study Area and Murray River Resource Management Zone in the Absence of Past and Present Effects

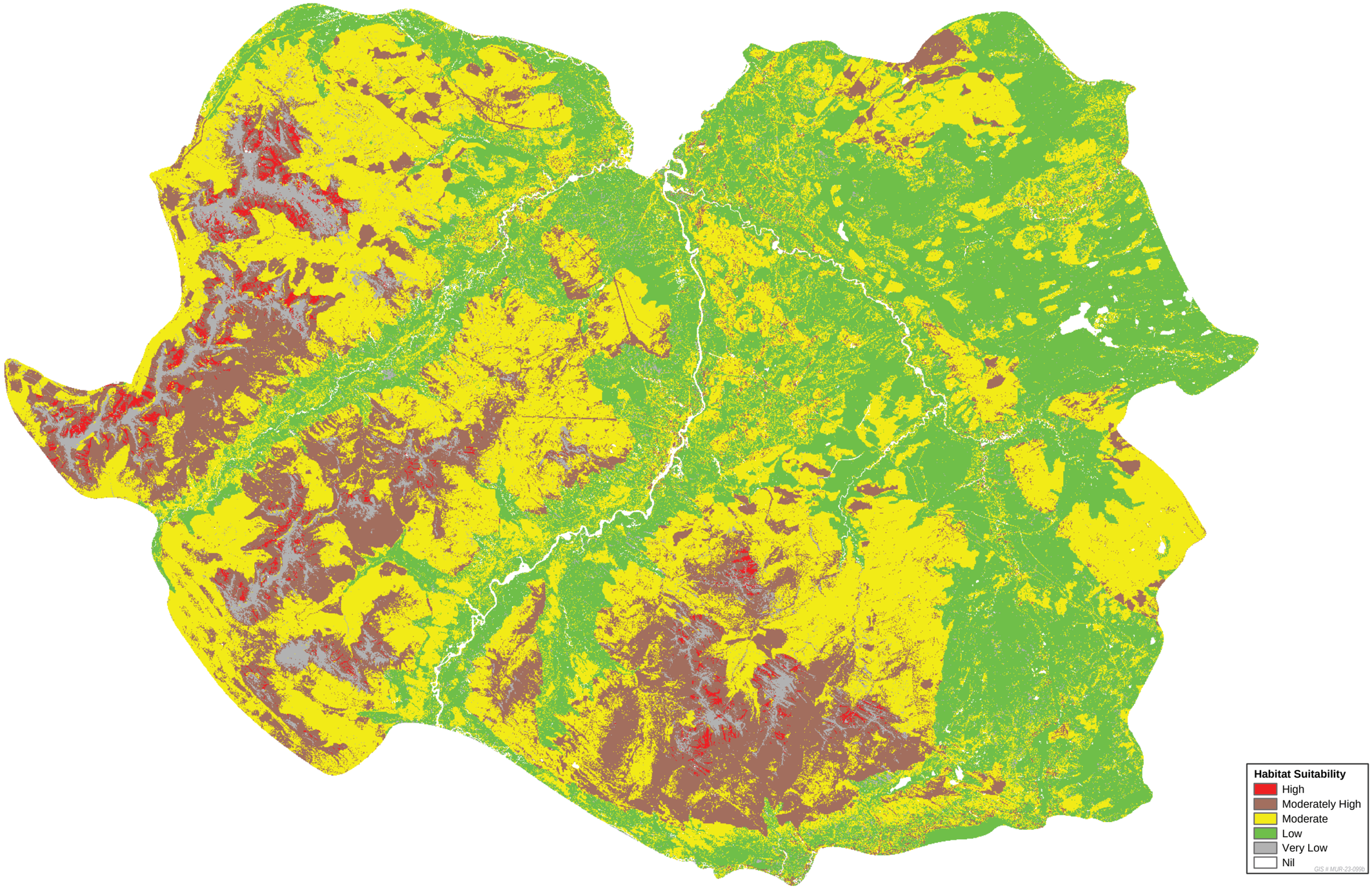


Figure 13.11-5
Grizzly Bear: Cumulative Effects of Developments on Habitat in the Regional Study Area and Murray River Resource Management Zone

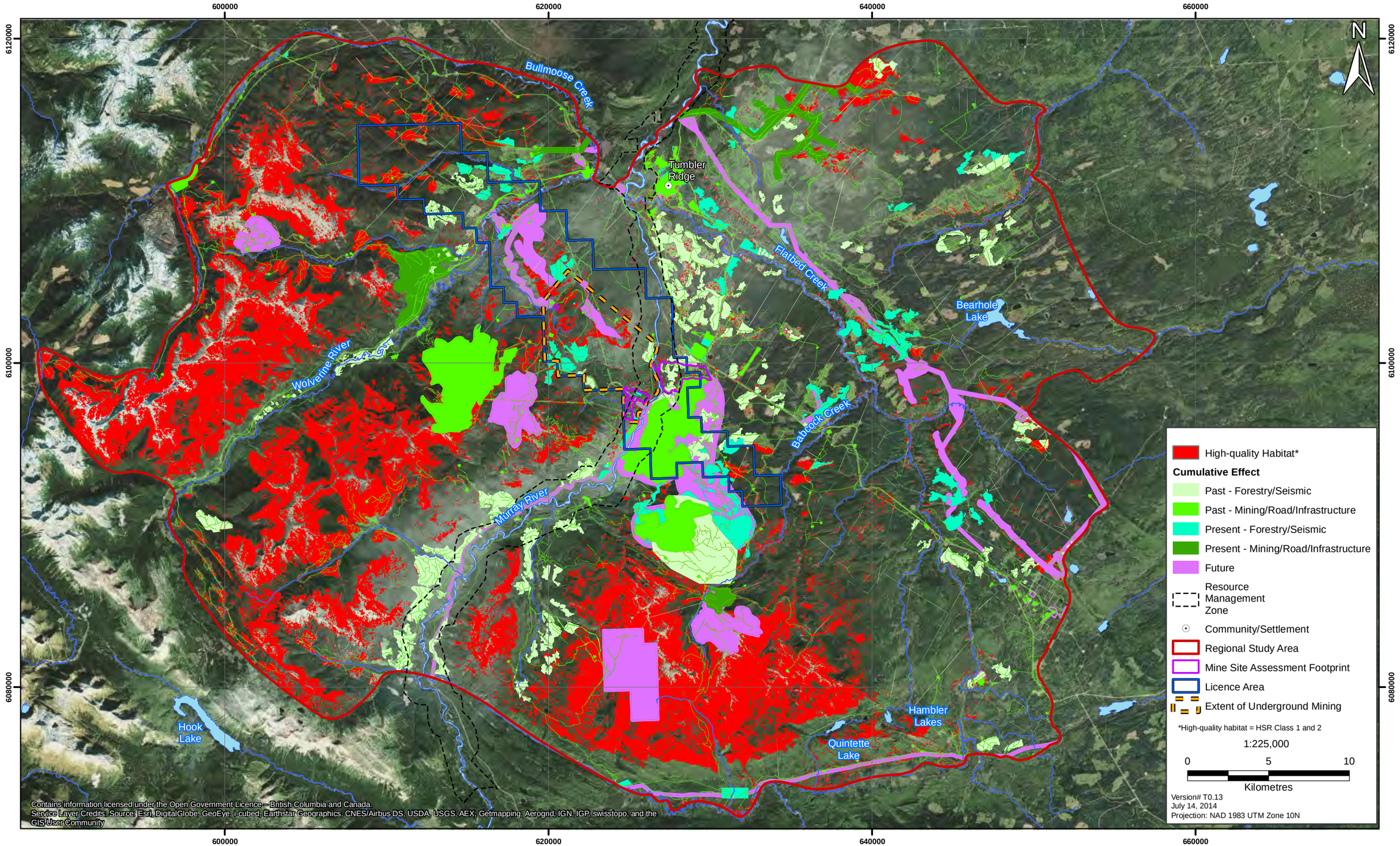


Table 13.11-5. Area of High-Quality Habitat Lost and Altered in the Past, Present and Future for Grizzly Bear in the MRRMZ

Time Period		Area of High-Quality Habitat Removed in the Riparian Management Zone (ha)												% of Total Lost and Altered		
		Past			Present			Murray River			Future					
Season		Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall
Total Pre-Disturbance		**1,282**	**227**	**328**												
Industry	**Effect**															
Forestry	Alteration	414	18	8	20	7	8				--	--	--	57.2	19.0	18.1
Seismic	Alteration	--	--	--	--	--	--				--	--	--	0.0	0.0	0.0
Mining	Loss	26	21	6	--	--	--	30	16	3	14	14	9	9.3	38.8	20.2
Mining	Alteration	6	4	2	--	--	--	10	10	3	6	5	3	2.9	14.6	8.3
Mining	Subsidence	--	--	--	--	--	--	5	3	1	--	--	--	0.7	2.1	1.0
Transportation	Loss	101	16	10	--	--	--							13.3	11.6	11.0
Wind	Loss	--	--	--	--	--	--				--	--	--	0.0	0.0	0.0
Wind	Alteration	--	--	--	--	--	--				4	1	0	0.5	1.0	0.5
Infrastructure	Loss	17	8	3	--	--	--				--	--	--	2.2	6.0	3.1
Oil and Gas	Lost	--	--	--	--	--	--				30	2	6	3.9	1.8	6.6
Oil and Gas	Alteration	--	--	--	--	--	--				76	7	29	10.0	5.1	31.2
Total Lost (ha)		144	45	19	0	0	0	30	16	3	44	17	15			
Total Altered (ha)		420	23	10	20	7	8	15	13	4	85	13	32			
% Lost		11.2	19.8	5.9	0.0	0.0	0.0	2.3	7.2	1.0	3.4	7.4	4.6			
% Altered		32.8	9.9	3.0	1.5	3.1	2.5	1.2	5.6	1.2	6.7	5.9	9.8			
Cumulative Area Lost (ha)		144	45	19	144	45	19	174	61	23	218	78	38			
Cumulative Area Altered (ha)		420	23	10	440	30	18	455	42	22	541	56	54			
Total Lost and Altered (ha)											**758**	**134**	**92**			
Cumulative % Lost		11.2	19.8	5.9	11.2	19.8	5.9	13.5	26.9	6.9	17.0	34.3	11.5			
Cumulative % Altered		32.8	9.9	3.0	34.3	13.0	5.5	35.5	18.7	6.7	42.2	24.6	16.5			

" – " Indicates that no projects were identified with this effect in Table 13.11-1.

Additional projects in the MRRMZ would remove and alter an additional 2% and 1% , respectively, (Murray River) and 3% and 7%, respectively (oil and gas), of spring habitat. The cumulative total of all past, present and future projects would be 17% lost and 42% altered of high-quality spring grizzly bear habitat in the MRRMZ. For this reason, the cumulative effect of disruption of movement on grizzly bear in the MRRMZ is considered a residual effect.

13.11.4 Cumulative Effects on Fisher

The effects assessment identified two potential residual effects for fisher; habitat loss and alteration and disruption of movement (Section 13.7.12). These potential effects were carried forward to the cumulative effects assessment and are evaluated for potential cumulative effects in the following sections.

13.11.4.1 Habitat Loss and Alteration

The distribution of fisher habitats predicted to occur in the absence of disturbance was calculated using the methods described in Section 13.11.1.4. Winter denning habitat for fisher under a no development scenario is displayed in Figure 13.11-6. The amount of high-quality habitat available in the RSA and the habitat loss and altered by past, present and future activities is reported in Table 13.11-6.

Overall, there is roughly half as much winter denning habitat in the RSA (12,892 ha) as there is growing habitat (spring, summer and fall; 27,892 ha; Table 13.11-6; Figure 13.11-7) so this analysis will focus on winter denning habitat as it is more limiting. Historic and present activities have removed approximately 3.1% of fisher denning habitat and altered 2.9% in the RSA. The majority of this loss and alteration is due to forestry and seismic lines (557 ha altered), mining (299 ha removed and 49 ha altered), and transportation infrastructure (215 ha removed).

The Murray River Project will remove and alter an additional 0.2% and 0.8%, respectively. Additional future activities include habitat loss from other proposed mines (109 ha) and habitat alteration by wind projects (123 ha) and oil and gas projects (100 ha).

If all future projects were added, an additional 1.2% of habitat would be lost and 2.8% of habitat would be altered in the RSA, for a total of 5.5% lost and 7.6% altered. Fisher home ranges in British Columbia vary between 890 ha for females and 1,800 ha for males. The cumulative loss of habitat in the RSA would be equivalent to 710 ha removed and 979 ha altered, or a total of 1,689 ha. This area corresponds to 1.8 female or 0.9 male fisher home ranges. Fisher have an intermediate ability to recover from population stresses (Banci and Proulx, 1999) – higher than ungulates such as moose. As a consequence, this loss of habitat is not considered a residual cumulative effect for fisher, despite having a similar proportion of habitat loss to moose in the RSA.

13.11.4.2 Disruption of Movement

The area of high quality habitat for fisher that has been or may be lost due to development in the MRRMZ is displayed in Table 13.11-7 and Figure 13.11-7. The MRRMZ contains approximately 1,315 ha of winter denning habitat and 2,934 ha of growing season (spring, summer and fall) habitat.

Table 13.11-6. Area of High-Quality Habitat Lost and Altered in the Past, Present and Future for Fisher in the RSA

Time Period		Area of High-Quality Habitat Removed in the RSA (ha)								% of Total Lost and Altered	
		Past		Present		Murray River		Future			
Season		Winter	Growing	Winter	Growing	Winter	Growing	Winter	Growing	Winter	Growing
Total Pre-Disturbance		**12,892**	**27,530**								
Industry	**Effect**										
Forestry	Alteration	315	458	207	658			--	--	30.9	28.7
Seismic	Alteration	35	78	--	--			1	2	2.1	2.1
Mining	Loss	138	534	161	221	22	85	109	230	25.5	27.5
Mining	Alteration	22	50	29	35	14	44	29	46	5.5	4.5
Mining	Subsidence	--	--	--	--	96	271	--	--	5.7	7.0
Transportation	Loss	215	432	--	--			--	--	12.7	11.1
Wind	Loss	--	--	12	60			--	--	0.7	1.5
Wind	Alteration	--	--	10	58			123	298	7.8	9.2
Infrastructure	Loss	44	149	--	--			--	--	2.6	3.8
Oil and Gas	Lost	--	--	--	--			21	45	1.2	1.2
Oil and Gas	Alteration	--	--	--	--			100	196	5.9	5.1
Total Lost (ha)		397	1115	161	221	22	85	129	275		
Total Altered (ha)		371	586	245	751	109	314	253	543		
% Lost		3.1	4.1	1.3	0.8	0.2	0.3	1.0	1.0		
% Altered		2.9	2.1	1.9	2.7	0.8	1.1	2.0	2.0		
Cumulative Area Lost (ha)		397	1,115	559	1,336	581	1,421	710	1,695		
Cumulative Area Altered (ha)		371	586	617	1,337	726	1,651	979	2,193		
Total Lost and Altered (ha)								**1,689**	**3,889**		
Cumulative % Lost		3.1	4.1	4.3	4.9	4.5	5.2	5.5	6.2		
Cumulative % Altered		2.9	2.1	4.8	4.9	5.6	6.0	7.6	8.0		

" – " Indicates that no projects were identified with this effect in Table 13.11-1.

Table 13.11-7. Area of High-Quality Habitat Lost and Altered in the Past, Present and Future for Fisher in the MRRMZ

Time Period		Area of High-Quality Habitat Removed in the Riparian Management Zone (ha)								% of Total Lost and Altered	
		Past		Present		Murray River		Future			
Season		Winter	Growing	Winter	Growing	Winter	Growing	Winter	Growing	Winter	Growing
Total Pre-Disturbance		**1315**	**2934**								
Industry	**Effect**										
Forestry	Alteration	45.2	84.1	7.1	18.6			--	--	21.2%	16.1%
Seismic	Alteration	0.0	0.0	--	--			--	--	0.0%	0.0%
Mining	Loss	36.5	159.5	--	--	12.6	35.8	25.5	45.5	30.3%	37.7%
Mining	Alteration	2.8	12.2			8.3	23.1	9.3	14.9	8.3%	7.9%
Mining	Subsidence	--	--	--	--	3.8	67.1	--	--	1.5%	10.5%
Transportation	Loss	34.8	65.1					--	--	14.1%	10.2%
Wind	Loss	--	--	0.2	6.3			--	--	0.1%	1.0%
Wind	Alteration	--	--	0.1	2.4			2.6	13.3	1.1%	2.5%
Infrastructure	Loss	3.4	6.1	--	--					1.4%	1.0%
Oil and Gas	Lost	--	--	--	--			6.0	9.5	2.4%	1.5%
Oil and Gas	Alteration	--	--	--	--			48.4	81.0	19.6%	12.7%
Total Lost (ha)		75	231	0	0	13	36	31	55		
Total Altered (ha)		48	96	7	21	12	90	60	109		
% Lost		5.7	7.9	0.0	0.0	1.0	1.2	2.4	1.9		
% Altered		3.7	3.3	0.5	0.7	0.9	3.1	4.6	3.7		
Cumulative Area Lost (ha)		75	231	75	231	87	266	119	321		
Cumulative Area Altered (ha)		48	96	55	117	67	207	128	317		
Total Lost and Altered (ha)								**246**	**638**		
Cumulative % Lost		5.7	7.9	5.7	7.9	6.6	9.1	9.0	11.0		
Cumulative % Altered		3.7	3.3	4.2	4.0	5.1	7.1	9.7	10.8		

" – " Indicates that no projects were identified with this effect in Table 13.11-1.

Figure 13.11-6

Fisher: High-Quality Habitat in the Regional Study Area and Murray River Resource Management Zone in the Absence of Past and Present Effects

ERM

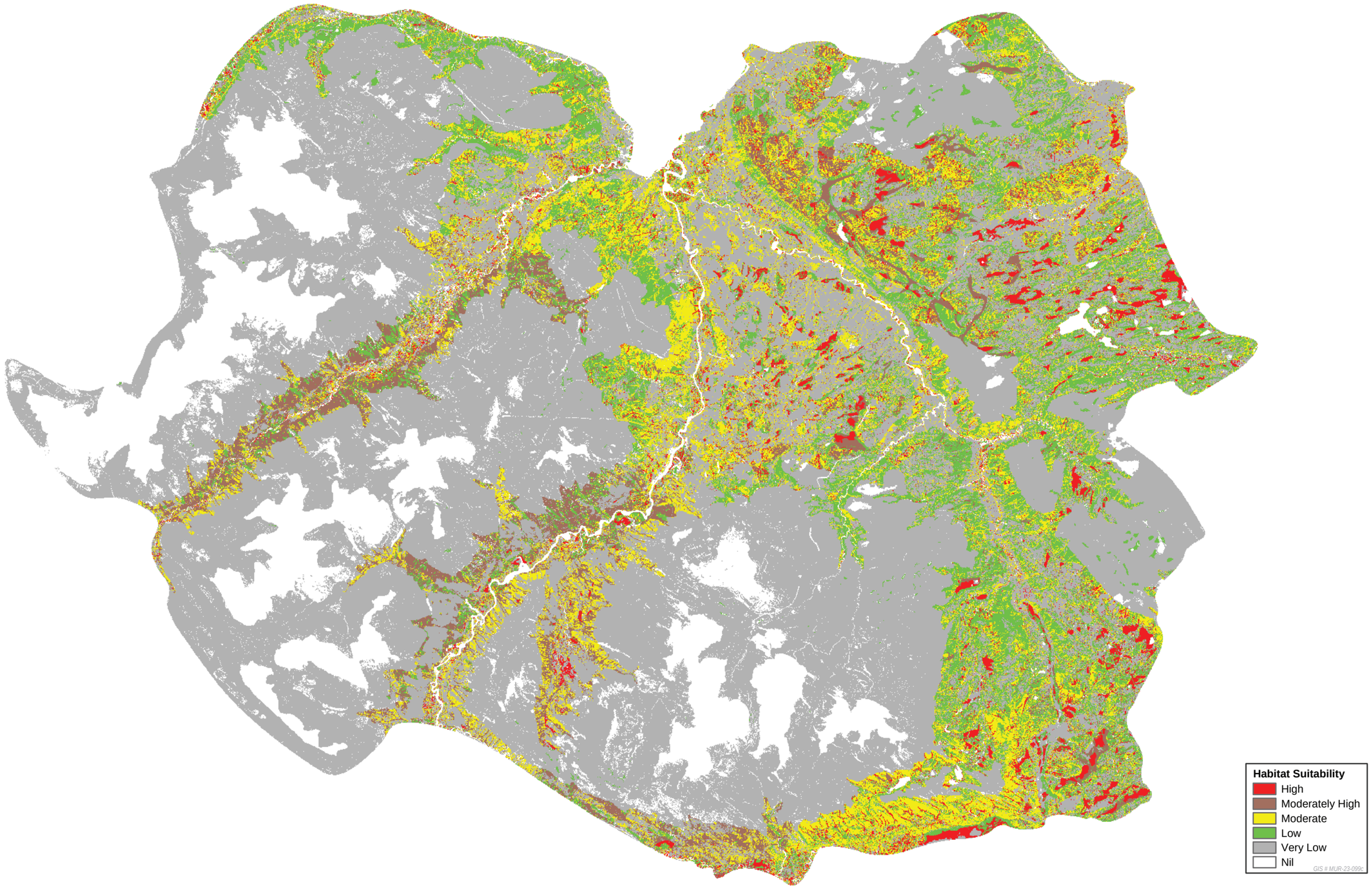
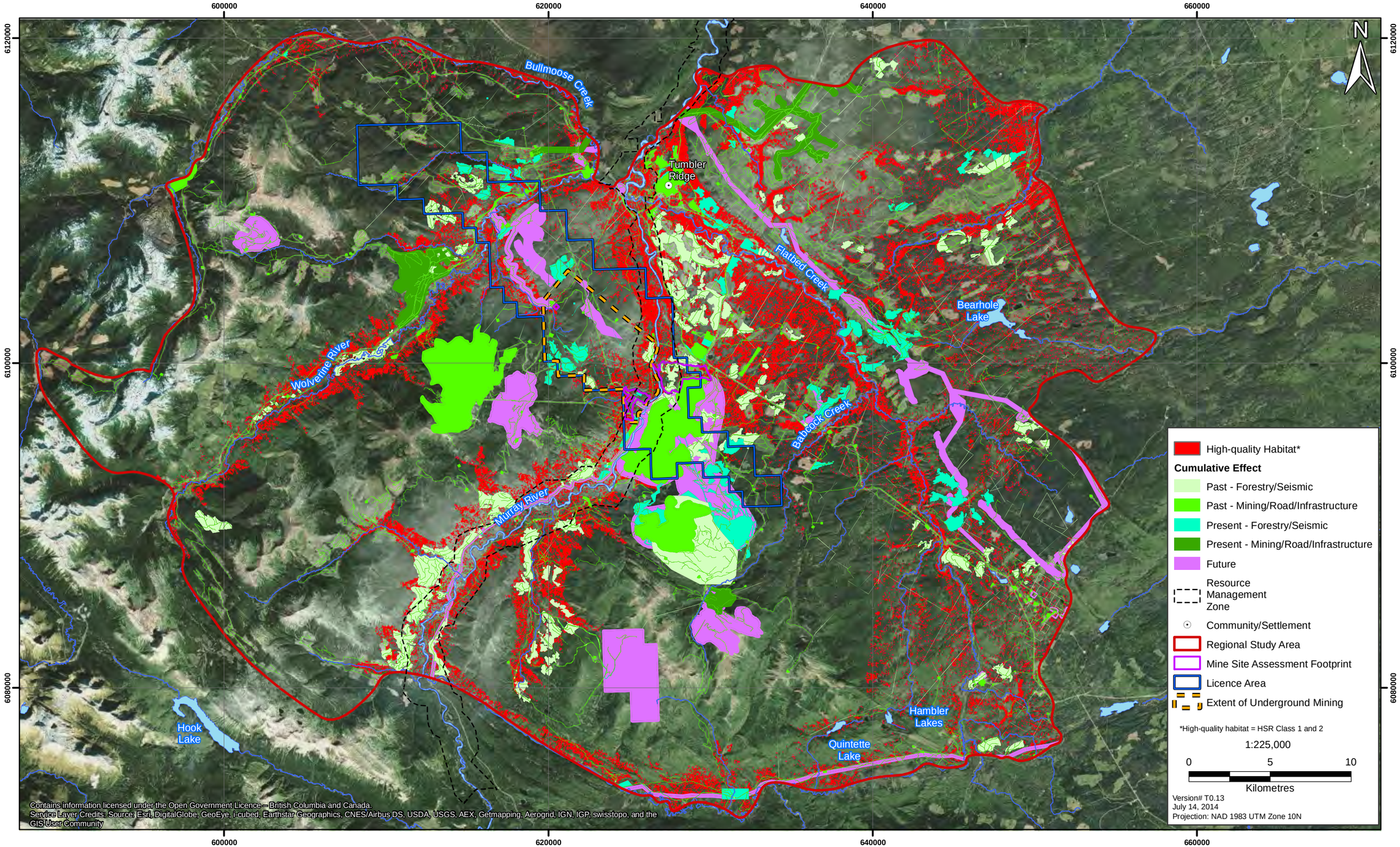


Figure 13.11-7
Fisher: Cumulative Effects of Developments on Habitat in the Regional Study Area and Murray River Resource Management Zone



The combination of past and present activities have removed approximately 5.7% and altered 4.2% of fisher habitat in the MRRMZ. The addition of the Murray River Project would remove and alter an additional 1.0% and 0.9% of this area. Other future projects would remove and alter an additional 2.4% and 4.6% of this habitat. The cumulative effect of all past, present and future activities in the MMRMZ would result in habitat loss (119 ha, 9%) and alteration (128 ha, 9.7%). This area is concentrated at or near the Murray FSR bridge over the Murray River. However, past, present and future developments plan to leave a 400-500 m buffer between project footprints and the river. This 1 km – wide corridor is likely able to satisfy the movement requirements of fisher along the Murray River. As a consequence, this effect is not rated as a residual effect for fisher.

13.11.5 Mitigation Measures for Cumulative Effects on Moose and Grizzly Bear

The Wildlife Management Plan (Section 24.12) describes the mitigation and management activities that are designed to reduce or eliminate potential effects to wildlife due to the Project. Mitigation measures specific to moose are described in the following sections. It is assumed that other current and future projects will be using similar mitigation measures for moose and grizzly bears, which are industry-standard best practices.

13.11.5.1 Mitigation for Habitat Loss and Alteration

Mitigation for direct habitat loss and alteration on moose and/or grizzly bears will include, but is not limited to:

- avoidance of important habitat where practical alternatives are available (e.g. habitat loss and alteration was minimized through Project design);
- maintain known and potential mineral licks in a natural state and ensure ungulates have access to them during the season when they are most used;
- no destruction or disruption of areas that contain known wallows, particularly during the ungulate breeding season during site clearing in the construction phase and during Construction and Operation; and,
- re-vegetation of some reclaimed components during Decommissioning and Reclamation.

13.11.5.2 Mitigation for Disruption of Movement

The effects of disruption to movement on all wildlife will be minimized through mitigation measures outlined in the Wildlife Management Plan (Section 24.12). The effect of disruption of movement will largely be mitigated by the same mitigation measures for habitat loss (Section 13.7.10.1) and sensory disturbance (Section 13.7.10.2). Additional mitigation measures for the disruption of movements for grizzly bears and moose will include but are not limited to maintaining a 1 km buffer along the Murray River (500 m to other side of the river).

13.11.6 Description of Potential Cumulative Effects

Table 13.11-8 summarizes the residual effects identified in Sections 13.11.2 through 4. These residual effects are then evaluated for significance in Sections 13.11.8 and 13.11.9.

Table 13.11-8. Summary of Residual Cumulative Effects on Wildlife and Wildlife Habitat

Valued Component	Murray River Activity	Other Human Action Activity	Description of Potential Cumulative Effect	Description of Mitigation Measure(s)	Description of Residual Cumulative Effect
Moose	Construction of Project footprint	Footprints of other mining projects, road corridors and other infrastructure. Clearing of vegetation for forestry and seismic lines.	Habitat Loss and Alteration	Reducing footprint to smallest possible size, avoiding salt licks, limiting noise disturbance.	Reduction in available high-quality habitat.
	Construction of the Project footprint in the MRRMZ	Construction of mining and related road footprints in the MRRMZ	Disruption to Movement	Reducing footprint to smallest possible size, speed limits, avoiding salt licks, limiting noise disturbance.	Reducing movement of moose along the Murray River.
Grizzly Bear	Construction of the Project footprint in the MRRMZ	Construction of mining and related road footprints in the MRRMZ	Disruption to Movement	Reducing footprint to smallest possible size, speed limits, limiting noise disturbance.	Reducing the movement of grizzly bear along the Murray River.

13.11.7 Evaluating the Significance of Residual Cumulative Effects for Moose

Two potential effects were rated as residual cumulative effects for moose: habitat loss and alteration and disruption of movement. The significance of these potential effects is evaluated in the following sections.

13.11.7.1 Significance of Residual Cumulative Effect of Habitat Loss and Alteration on Moose

Past and present developments in the RSA have resulted in the loss and alteration of 4.9% and 3.5% of moose habitat, respectively. The Murray River project is located at low elevation, in moose winter and will remove and alter an additional 0.2% and 0.7% of late winter habitat. Additional future projects will remove and alter an additional 0.9% and 3.1% of moose late winter habitat. The majority of future effects are due to, in decreasing order: wind power projects, oil and gas, and mining.

Approximately 540 ha (32%) of the area affected has been due to forestry operations, which produce good quality habitat for moose. Future forestry operations are difficult to predict, but will likely continue as a similar proportion of the total development in the RSA. This would result in a future scenario where approximately 1/3 of development may be increasing the quality of moose habitat (Yukon Department of Renewable Resources, 1996; Serrouya and D'Eon, 2002). This may be higher, if the right of way for future oil and gas pipelines is considered.

The total area of habitat removed due to all past, present and future activities is 1,178 ha of winter habitat, or 5.9% of the high quality habitat in the RSA. Assuming a moose density of 0.003 moose/ha, this area is equivalent to the home ranges of 3.5 moose.

The magnitude was rated as minor due to a relatively small amount of habitat loss and the fact that several forms of habitat alteration are beneficial to the moose population. The definition for minor magnitude in the assessment is: "differs from the average value for baseline conditions to a small degree (e.g., within the range of natural variation of the local population and well below a guideline or threshold value)."

The extent of the effect is landscape, as it is limited to the RSA. The duration is far future, because not all habitat will be reclaimed and it will take several decades for effective habitat to be produced in reclaimed areas. The frequency of the events leading to habitat loss (i.e., vegetation clearing) is sporadic.

The effect is reversible as both forestry and most mining operations are suitable for reclamation post-closure. The resiliency of the moose population to disturbed and fragmented habitat is relatively high. The moose population in WMU 7-21 was stable between 1993 and 2006 (Rowe 2006); however, the population has not been surveyed since 2006 and the current status is unknown. The ecological context of the moose population is neutral – moose are common throughout BC, but some populations in BC are known to be in decline.

Due to this minor rating for the magnitude of habitat removal and alteration, the cumulative effect of habitat loss and alteration for moose is assessed as **not significant (minor)**.

13.11.7.2 Characterization of Likelihood and Confidence for Residual Effects Conclusions for Habitat Loss and Alteration on Moose

The probability of the effect occurring is high for the loss of habitat in the RSA – most of the habitat loss and alteration has already occurred. The confidence in the significance rating is medium due to uncertainty in predicting future development scenarios. There is also uncertainty in the current moose population status.

13.11.7.3 Significance of Residual Cumulative Effects of Disruption to Movement on Moose

The distribution of infrastructure along Murray River due to mining and forestry operations was evaluated as a residual cumulative effect on the disruption of movement of moose north and south through the Murray River corridor. The Wolverine River corridor will be relatively unaffected by the Project, with the exception of rail traffic twice a day. The combination of all past, present and future activities on the MRRMZ will result in the removal of 9.8% (155 ha) of winter habitat and the further alteration of an additional 14.2% (224 ha) of habitat. Altered habitat includes forestry operations, the subsidence zone of the Murray River Project and cleared pipeline rights of way. These areas are generally not considered impediments to moose movement.

After mitigation, the residual effect of disruption of moose movements is expected to have a minor magnitude (Table 13.11-9). The extent of this effect will be at the landscape scale because moose north and south of the Project area may be affected as they travel along the Murray River corridor.

Table 13.11-9. Characterization of Residual Cumulative Effects, Significance, Likelihood, and Confidence on Moose

Cumulative Residual Effect	Residual Cumulative Effects Characterization Criteria							Significance of Adverse Residual Cumulative Effects *Not significant (minor, moderate); Significant (major)*	Likelihood and Confidence	
	Magnitude (*minor, moderate, major*)	Duration (*short-term, medium-term, long-term, far future*)	Frequency (*once, sporadic, regular, continuous*)	Geographic Extent (*local, landscape, regional, beyond regional*)	Reversibility (*reversible short-term, reversible medium-term, reversible long-term, permanent*)	Resiliency (*low, neutral, high*)	Context (*low, neutral, high*)		Probability (*low, medium, high*)	Confidence (*low, medium, high*)
Habitat Loss and Alteration	Minor	Far Future	Sporadic	Landscape	Reversible Long-term	High	Neutral	Not Significant (minor)	High	Medium
Disruption of Movement	Minor	Far Future	Sporadic	Landscape	Reversible Long-term	High	Neutral	Not Significant (minor)	Medium	Medium

The duration will be far future because it will take several decades for reclaimed areas from several Projects to recover into useful moose habitat that will facilitate movement. The frequency will be sporadic, as movements by moose may only be disrupted when moose are travelling through this developed portion of the Murray River. The effect will be reversible long term because of reclamation activities of development areas along the Murray River. The resiliency of the moose population to disturbed and fragmented habitat is relatively high. The ecological context of the moose population is neutral – moose are common throughout BC, but some populations in BC are known to be in decline. The cumulative effect of disruption of moose movement is assessed as **not significant (minor)**.

13.11.7.4 Characterization of Likelihood and Confidence for Residual Effects Conclusions for Disruption to Movement on Moose

The likelihood that the cumulative effects of the Projects will reduce movements of moose along the river is medium – moose are known to avoid crossing open areas with human activity (Table 13.11-9). The confidence that moose are using the Murray River as a movement corridor is moderate because it is a good assumption that these valleys are movement corridors for moose.

13.11.8 Evaluating the Significance of Residual Cumulative Effects for Grizzly Bear

One potential cumulative effect was rated as a residual effect for grizzly bears – the effect of disruption of movement along the Murray River.

13.11.8.1 Significance of Residual Effects of Disruption to Movement on Grizzly Bears

Roads and infrastructure may act as barriers to grizzly bear movements, reducing connectivity between seasonal habitats. Grizzly bears frequently alter their behaviour and avoid areas with human activity (such as high-use roads) and periods when humans are most active (Mueller 2001). Bears use a variety of habitats for movement, from riparian in the spring to alpine in the summer and fall. Since grizzly bear are more sensitive to human presence than other wildlife VCs, the potential for the all the Projects to disrupt movement of bears along the Murray River was rated as a cumulative residual effect. Currently, 11.2% of grizzly bear spring habitat has been lost in the MRRMZ, largely due to transportation corridors and 34.3% has been altered, largely by forestry. The addition of the Murray River project would remove an additional 2.3% and alter an additional 1.2% of spring habitat for grizzly bears in the MRRMZ. Additional future projects, largely oil and gas, may cause the loss and alteration of an additional 3.4% and 6.7% of spring habitat for a total of 17% lost and 42% altered. Note that the altered habitat is largely forestry cutblocks and pipeline rights of way, which grizzly bears may use to forage or movements (Nielsen et al. 2004). Due to the relatively high proportion of habitat lost and altered in the MRRMZ, the magnitude of the effect is rated as medium (Table 13.11-10).

This effect is mitigated, to some degree, by the movement habits of grizzly bears. Bears have very large home ranges and move across the landscape continuously and have a variety of habitats that they use for movement, including riparian, mid elevation and alpine. It is not expected that this effect will have local or regional population-scale effects.

The geographic extent of this effect will be landscape because the effect will be tied to the population of bears in the RSA. The duration will be far-future.

Table 13.11-10. Characterization of Residual Cumulative Effects, Significance, Likelihood, and Confidence on Grizzly Bear

Cumulative Residual Effect	Residual Cumulative Effects Characterization Criteria							Significance of Adverse Residual Cumulative Effects *Not significant (minor, moderate); Significant (major)*	Likelihood and Confidence	
	Magnitude (*minor, moderate, major*)	**Duration** (*short-term, medium-term, long-term, far future*)	**Frequency** (*once, sporadic, regular, continuous*)	**Geographic Extent** (*local, landscape, regional, beyond regional*)	**Reversibility** (*reversible short-term, reversible medium-term, reversible long-term, permanent*)	**Resiliency** (*low, neutral, high*)	**Context** (*low, neutral, high*)		**Probability** (*low, medium, high*)	**Confidence** (*low, medium, high*)
Disruption of Movement	Medium	Far Future	Sporadic	Landscape	Reversible Long-term	Low	Neutral	Not Significant (moderate)	High	Medium

The frequency will be sporadic as grizzly bears encounter facilities and altered habitat in the MRRMZ. The effect will be reversible in the long-term once the projects end. Bears may temporarily avoid habitats where there is a barrier to their movement, but are expected to re-occupy the habitat once the disturbance is removed. The resiliency of grizzly bear populations to anthropogenic effects are generally considered to be low. Grizzly bears have low reproductive rates and are known to avoid human activity and so have population-level effects in anthropogenically-modified landscapes. The context is neutral for grizzly bears due to uncertainty regarding the status of the grizzly bear population in this region, but suitable habitat in the RSA is abundant.

The cumulative effect of disruption to grizzly bear movement is assessed as **not significant (moderate).**

13.11.8.2 Characterization of Likelihood and Confidence for Residual Effects Conclusions of Disruption of Movement on Grizzly Bear

The likelihood of this effect occurring is high for the MRRMZ (Table 13.11-10). The confidence is medium because no data exist on how often, and to what degree grizzly bears rely on using the MRRMZ as a movement corridor.

13.12 EFFECTS ASSESSMENT CONCLUSIONS FOR WILDLIFE AND WILDLIFE HABITAT

This section summarizes the conclusions from the effects assessment (EA) and the cumulative effects assessment (CEA) for wildlife and wildlife habitat. The Murray River Project has four characteristics which are important for the effects assessment for wildlife: 1) the project is underground and so relatively small, 2) the Project is at low elevation, 3) the Project occurs at the bottom of a river valley which is likely used as a movement corridor, 4) no new roads will be created for the Project and 5) the water quality is relatively good. These four characteristics largely define the outcomes of the EA and CEA.

Eleven wildlife VCs were scoped into the assessment: caribou, moose, mountain goat, elk, grizzly bear, fisher (furbearers), raptors, songbirds, waterbirds, and western toad (amphibians). Seven potential effects were evaluated for potential effects on wildlife VCs. Potential effect, key features of the Project that relate to each effect and relevant mitigation are presented in Table 13.12-1.

13.12.1.1 Summary of the Effects Assessment for Wildlife

Wildlife were evaluated for potential residual effects in Section 13.7 and evaluated for significance of residual effects in Section 13.9 and are summarized in Table 13.12-2.

Caribou were evaluated for three potential effects: 1) habitat loss and alteration, sensory disturbance and disruption of movement. Habitat suitability modeling for winter, growing (spring, summer and fall) and calving (June) seasons were compared with 1) the Project footprint, subsidence zone and buffers (habitat loss and alteration), 2) noise modeling results (sensory disturbance) and 3) distribution of roads and Project facilities (disruption of movement) to evaluate potential effects. No high quality caribou habitat occurred in the Project footprint, 27-52 ha occurred in the subsidence zone, 15 ha of habitat would be periodically disturbed by train noise, and no movement corridors would be affected for caribou. These areas are very small (<0.1% of caribou habitat) and the effects were considered small magnitude (e.g., subsidence will have little effect on caribou habitat).

Table 13.12-1. Description of Project Characteristics and Mitigation for each Potential Effect on Wildlife Valued Components

Potential Effect	Project Characteristics, Assessment Methods and Key Mitigation Actions
1) Habitat loss and alteration	• The Project footprint is relatively small because mining will be conducted underground and so do not include an open pit or extensive waste rock piles. • The various facilities are also relatively easy to reclaim to wildlife habitat. • The Project is located at low elevation – so species with ranges that occur at low elevation will have some habitat removed or affected, but species at high elevation (caribou and mountain goat) will not. • Habitat loss and alteration was evaluated by calculating the area of high quality habitat (using Habitat Suitability Modeling) in the Project footprint plus a buffer. • The subsidence zone (+200 m buffer) was evaluated as "affected" habitat, which is likely a large over-estimate of the effects of subsidence on wildlife habitat. • Design mitigation includes minimizing the Project footprint and avoiding important habitat features such as salt licks for ungulates.
2) Sensory disturbance	• Mining will occur underground, so Project will not produce much noise – no above ground blasting or heavy haul trucks. • The majority of noise will be due to generators and other static noise sources, vehicles, and trains which most wildlife species will adapt to. • Sensory disturbance was calculated as an area of habitat where wildlife may abandon, or be disturbed based on modeled noise levels for the mine site (45 dBA), vehicles and trains (75 dB Lpeak).
3) Disruption of movement	• The Project is located in the Murray River Resource Management Zone (MRRMZ), in the bottom of the Murray River Valley. Therefore, wildlife which use low elevation river valleys for movement may be affected. • Disruption of movement was evaluated by calculating the amount of high-quality habitat that would be lost for each species in the MRRMZ. • The current design leaves 400-500 m on either side of the river.
4) Direct mortality	• Vehicle-wildlife collisions can cause direct mortality. • The Project will not require the construction of any new road access. • Mitigation includes controlling vehicles speed on-site.
5) Indirect mortality	• New roads can lead to new access to hunters, resulting in increased indirect hunting mortality. • The Project will not require the construction of any new road access so this potential effect was scoped out for all wildlife VCs.
6) Attractants	• Wildlife such as grizzly bears and marten can be attracted remote facilities. • This effect is relatively easily mitigated through waste management policies, and employee education.
7) Chemical hazards	• Chemical hazards were evaluated through a risk assessment of water quality and dust deposition. • A chemical hazard analysis evaluated that on-site ponds will have levels of chemicals of potential concern (COPCs) above wildlife limits. • Selenium levels in stream M19A are also predicted to be above wildlife levels during winter. • Mitigation includes monitoring the water quality in on-site ponds and excluding waterfowl and amphibians if water quality is above wildlife standards. • Selenium levels in stream M19A will be above wildlife levels during winter, when both waterfowl and western toad will be absent. • Mitigation in stream M19A includes monitoring. • For most wildlife species, chemical hazards were scoped out of the assessment due to low levels of COPCs or the lack of an ingestion route to the wildlife VC.

Table 13.12-2. Summary of Project and Cumulative Residual Effects, Mitigation, and Significance for Wildlife and Wildlife Habitat

Residual Effects	Project Phase	Mitigation Measures	Significance of Residual Effects	
			Project	Cumulative
Moose				
Habitat Loss and Alteration	Construction and Operation	Reducing footprint to smallest possible size, speed limits, avoiding salt licks, limiting noise disturbance.	Not Significant (Minor)	Not Significant (Minor)
Disruption of Movement	Construction and Operation	Reducing footprint to smallest possible size, speed limits, avoiding salt licks, limiting noise disturbance.	Not Significant (Minor)	Not Significant (Minor)
Grizzly Bear				
Disruption of Movement	Construction and Operation	Reducing footprint to smallest possible size, speed limits, avoiding salt licks, limiting noise disturbance.	Not Significant (minor)	Not Significant (Moderate)
Fisher				
Habitat Loss and Alteration	Construction and Operation	Reducing footprint to smallest possible size, speed limits, avoiding salt licks, limiting noise disturbance.	Not Significant (Minor)	Not Residual
Disruption of Movement	Construction and Operation	Reducing footprint to smallest possible size, speed limits, avoiding salt licks, limiting noise disturbance.	Not Significant (minor)	Not Residual

The Project is located within the known annual range of the Quintette caribou herd (included in DU8 – Central Mountain subgroup of the Southern Mountain population of Woodland Caribou). Quintette core winter habitat, spring, summer and fall habitat were all modelled to be at high elevation. The Project is at low elevation and does not interact with areas of high-quality caribou habitat.

The Project is at low elevation in the Murray River valley. Low elevation habitat has been identified by both First Nations traditional knowledge and in the 2014 federal Recovery Strategy as an important component to meeting the life requisites of some woodland caribou herds. Currently, the Central Mountain subgroup is characterized by primarily high elevation habitat use year round. Under the current distribution and known patterns of habitat use by the Quintette herd defined by telemetry data, these animals migrate between high elevation winter habitat and high elevation summer habitat deeper and higher into the mountains with only transient use of low elevation areas as they move across valleys between adjacent ridges. After mitigation and reclamation, the effect of the Project on low elevation habitat is negligible. Given the short mine life relative to the anticipated time required for caribou recovery, the integrity of low elevation habitat will be maintained and will be available to caribou as the southern mountain population recovers and potentially expands back into low elevation areas. As a consequence, no residual effects were predicted for caribou.

Moose were evaluated in the same way as caribou, but with the addition of one potential effect of direct mortality. Disruption of movement was evaluated by examining the amount of high-quality habitat lost for moose in the MRRMZ, while direct mortality was evaluated through an examination of the Ministry of Transportation and Infrastructure (MOTI) Wildlife Accident Reporting System (WARS) database. Since high-quality moose habitat preferentially occurs at low elevation, particularly winter habitat, two residual effects were determined for moose – habitat loss and alteration, and disruption of movement. Neither of these effects were rated as significant effects in the effects assessment, but both were carried forward to the cumulative effects assessment.

Mountain goat were evaluated for habitat loss and alteration and sensory disturbance in the same way that caribou were evaluated. High-quality mountain goat habitat did not overlap with the Project footprint, subsidence zone, nor the noise disturbance areas and no residual effects were predicted for mountain goat.

Elk were evaluated for the same four potential effects as moose (habitat loss and alteration, sensory disturbance, disruption of movement and direct mortality). Unlike moose, elk are grazers and acclimate to low levels of human disturbance, readily using reclaimed mine sites and moving through semi-disturbed landscapes. Elk also have larger winter habitat areas than moose and are less restricted to valley bottom areas. As a consequence, no residual effects were predicted for elk.

Grizzly bears were evaluated for the same effects as moose and elk, plus a fifth effect of attractants to facilities. The footprint, subsidence and noise profiles overlapped a small proportion of grizzly habitat in the RSA, leading to non-residual effects due to habitat loss and alteration and sensory disturbance. Grizzly bears are known to avoid even low levels of human disturbance (except when attracted to food) and grizzly bears use low elevation habitat preferentially during the spring, such as the Murray River valley. Therefore, a residual effect of disruption of movement was assigned to grizzly bear. Potential effects due to attractants are relatively easily mitigated and were not rated as a residual effect. The effect of disruption of movement was evaluated as not significant, but carried forward to the cumulative effects assessment.

Fisher was evaluated as a proxy for the group of furbearers for five effects: habitat loss, sensory disturbance, disruption of movement, direct mortality and attractants to camps. Sensory disturbance was deemed to cover a relatively small area of high-quality habitat and so was not rated as a residual effect, while both direct mortality and attractants can be effectively mitigated for and were not rated as residual effects. Because high-quality habitat for fisher is concentrated in valley bottoms, both habitat loss and disruption of movement in the MRRMZ were rated as residual effects, although both were rated as not significant effects.

Bats were evaluated for habitat loss and alteration, sensory disturbance, direct mortality and attractants to structures. Mitigation measures included pre-construction surveys, directed lighting, and excluding bats from buildings. With these mitigations, none of these effects were rated as residual effects.

Raptors and songbirds were evaluated for habitat loss and alteration, sensory disturbance and direct mortality. The area of habitat lost and disturbed by noise was rated as a small component of habitat available in the RSA and neither of these effects were rated as residual effects. Direct mortality will

be mitigated by conducting clearing outside of the bird breeding season or conducting pre-clearing surveys during the bird breeding season and this effect was therefore not rated as residual.

Waterfowl, like raptors and songbirds, were also rated for habitat loss and alteration, sensory disturbance and direct mortality and these effects were rated as not residual for the same reasons. Waterfowl were also evaluated for the effects due to chemicals of potential concern (COPCs) in on-site water storage ponds and the wetlands along stream M19. Waterfowl can use on-site ponds at industrial sites, particularly during migration. Water quality in the on-site ponds will likely contain COPCs above wildlife guidelines. Mitigation for on-site ponds includes water testing and exclusion of waterfowl if COPCs in water exceed wildlife guidelines. Exposure to selenium in stream M19A was determined to be unlikely because waterfowl are not present during the winter when the selenium concentrations are expected to exceed guidelines. As a consequence, chemical hazards for waterfowl were not rated as a residual effect for waterfowl.

Western toad was evaluated as a proxy for the group of amphibians for five potential effects: habitat loss and alteration, disruption of movement, direct mortality, attractants and chemical hazards. Mitigation for toads included clearing outside of the breeding season, pre-clearing surveys during the breeding season, monitoring of roads and ditches to limit disruption of movement, direct mortality and attraction to roadside ditches for breeding. Chemical hazards were mitigated through water sampling in on-site ponds and exclusion of toads from these ponds if water quality is low and toads are found to be breeding in these ponds.

13.12.1.2 Summary of the Cumulative Effects Assessment for Wildlife

Three wildlife VCs were carried forward to the cumulative effects assessment: moose, grizzly bear and furbearers. All three were carried forward because they preferentially use low elevation areas, where the Project is located, as habitat or movement corridors during certain parts of the year.

Cumulative effects were evaluated using habitat suitability maps for the RSA, which were created from a vegetation map that approximates the current vegetation community without disturbance from industrial activities (Section 13.11.1). Habitat loss and alteration was evaluated by comparing the area of high-quality habitat lost and altered due to past, current, Murray River project and other projects compared to the amount of habitat in the RSA. Disruption of movement was evaluated by comparing the areas lost and altered for the same activities in the Murray River Resource Management Zone (MRRMZ).

Moose were evaluated for two potential cumulative effects – habitat loss and disruption of movement. To date, approximately 5% of winter habitat has been removed, largely by infrastructure, roads and mining, and 3.5% has been altered, mostly by forestry and seismic lines. If all projects go ahead in the future, then approximately 6% of habitat will be lost and 7.3% will be altered, for a total of approximately 13% lost or altered. Approximately 5.7% and 5.2% have been lost and altered to date in the MMRMZ and this will increase to 9.8% and 14.2%, respectively, if all projects go ahead. As a consequence, both effects were rated as cumulative residual effects on moose, however both were rated as not significant (minor) (Table 13.12-2) because moose are relatively resilient to disturbed landscapes and because much of the habitat alteration (forestry, seismic, etc.) is beneficial or neutral for moose since it replaces forest with early seral forage.

Grizzly bear were evaluated for one potential cumulative effect - disruption of movement in the MRRMZ. Grizzly bear preferentially use low elevation areas in the spring, such as the Murray River valley – of which 11.2% of high-quality habitat has been lost and 34% has been altered in the MRRMZ to date. If all projects go ahead, this will result in 17% lost and 42% altered. Grizzly bears typically avoid human activities and fragmented habitats, and may have their movement disrupted in the Murray River valley as a consequence. This effect was rated as a residual cumulative effect with a not significant (moderate) rating (Table 13.12-2). This rating was chosen because several grizzly bear traits mitigate the loss of habitat in the valley – grizzly bears will move through forestry areas, which make up the majority of the altered area, and grizzly bears use valley bottoms preferentially in the spring and higher elevation areas for the rest of the growing season. Therefore, the potential effect on grizzly bears is not as high a magnitude as the habitat loss and alteration calculations appear in the MMRMZ.

Fisher, as a proxy for furbearers, was evaluated for two potential effects – habitat loss and alteration and disruption of movement. The high-quality habitat areas lost and altered in the RSA are currently 4.3% and 4.8%, respectively, and will rise to 5.5% and 7.6% if all projects proceed. Habitat loss and alteration in the MRRMZ is currently 5.7% and 4.2%, respectively, and will rise to 9% and 9.7% if all projects go ahead. Fisher are sensitive to habitat fragmentation and alteration, but have some ability to adjust to relatively low levels of disturbance, as appears to be the case in the RSA and MRRMZ. Hence, neither habitat loss and alteration, nor disruption of movement was evaluated as residual effects for fisher (Table 13.12-2).

REFERENCES

Definitions of the acronyms and abbreviations used in this reference list can be found in the Glossary and Abbreviations section.

1994a. *Migratory Birds Convention Act*, SC. C. 22.

1994b. *Migratory Birds Convention Act*, C. Chapter M-7.01, c. 22.

1996a. *Land Act*, RSBC. C. 245.

1996b. *Wildlife Act*, RSBC. C. 488.

2002. *Species at Risk Act*, SC. C. 29.

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