14 WILDLIFE RESOURCES

14.1 Approach

Wildlife resources was selected as a valued component (VC) due to:

- An interaction with Project components and activities resulting in the loss or fragmentation of feeding, breeding, or winter habitat from dam construction and reservoir filling
- Aboriginal concerns of effects on biodiversity, loss of habitat, changes in animal populations and their distribution, and effects on traditional land use practices
- Public and stakeholder concerns of effects on biodiversity, loss of habitat, and changes in animal populations and their distribution
- Federal and provincial regulations on wildlife, biodiversity and conservation

The wildlife resources VC includes the following key species groups: butterflies and dragonflies, amphibians and reptiles, migratory birds, non-migratory game birds, raptors, bats, fur-bearers, ungulates, and large carnivores.

14.1.1 Regulatory and Policy Setting

The following is a summary of federal and provincial legislation governing wildlife resources.

14.1.1.1 *Canadian Wildlife Act*

The *Canadian Wildlife Act* outlines the powers of the federal government to protect wildlife, in cooperation with provinces and territories. The Act enables the Canadian Wildlife Service (CWS), in cooperation with provincial and territorial governments, to take measures to protect endangered wildlife species and acquire land for wildlife research, conservation, and interpretation.

14.1.1.2 *Migratory Birds Convention Act*

The *Migratory Birds Convention Act, 1994* is administered by the Wildlife Enforcement Division of Environment Canada, in cooperation with provincial and territorial governments. The Act is enforced and regulated by CWS, the Royal Canadian Mounted Police and provincial or territorial law enforcement authorities. A “migratory bird” referred to in the Convention includes the sperm, eggs, embryos, juveniles, adults, tissue cultures, and parts of the bird. This includes waterfowl, woodpeckers, cranes, rails and coots, shorebirds – including gulls and terns, pigeons and doves, insectivorous songbirds (excluding blackbirds), seabirds, loons, grebes, herons, egrets, and bitterns.

The Migratory Birds Regulations exist under the *Migratory Birds Convention Act*, and are in place to carry out the purposes and provisions of the Act. The Migratory Birds Regulations concern the conservation and protection of migratory birds. The Migratory Birds Regulations control hunting and possession of migratory game birds; the sale, purchase, or shipment of migratory birds, their nests, or their eggs; scientific collection, aviculture, and taxidermy; activities designed to reduce the damage that migratory birds

cause to crops or other property and the danger they pose to aircraft; and requirements for hunters to use non-toxic shot for most migratory game bird species.

The following prohibition applies to land development projects, under the Migratory Birds Regulations:

> "Section 6. No person shall:
>
> *(a) Disturb, destroy or take a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird, or*
>
> *(b) Have in his possession a live migratory bird, or a carcass, skin, nest or egg of a migratory bird*
>
> except under authority of ~~a special~~ a permit therefor". ~~or as provided in the Migratory Bird Sanctuary Regulations."~~

14.1.1.3 *Species at Risk Act*

The Government of Canada proclaimed the federal *Species at Risk Act* (SARA) in June 2003 as part of a three-part strategy for the protection of species at risk in Canada. The other two parts of the strategy include the Accord for the Protection of Species at Risk and the Habitat Stewardship Program for Species at Risk. SARA was developed following the implementation of the Canadian Biodiversity Strategy, in response to the United Nations Convention on Biological Diversity. The purpose of SARA, per the Species at Risk Public Registry, is to "to prevent Canadian indigenous species, subspecies, and distinct populations from becoming extirpated or extinct, to provide for the recovery of endangered or threatened species, and encourage the management of other species to prevent them from becoming at risk".

SARA-listed wildlife species occur within the Peace River valley. The Peace River valley is defined as a linear area incorporating the Peace River and its associated gravel bars, terraces, and side slopes, extending to the top of the slope at the level of the surrounding plateau.

14.1.1.4 *British Columbia Wildlife Act*

In the B.C. *Wildlife Act*, "wildlife" refers to "raptors, threatened species, endangered species, game or other species of vertebrates prescribed as wildlife". Birds are protected under Section 34 (see below); this includes "birds described in the American Ornithologists Union Checklist of North American Birds, 6th edition or its supplements, which are native to Canada or the United States of America and were not introduced by man". Some species, including Eurasian Skylarks (*Alauda arvensis*), all raptors, and some native and some introduced upland game birds, have additional protection. ~~Some~~ A few species ~~that~~ are exempt for management reasons ~~include~~ – these are crows, European Starlings (*Sturnus vulgaris*), Rock Pigeons (*Columba livia*), Brown-headed Cowbirds (*Molothrus ater*), House Sparrows (*Passer domesticus*), and Black-billed Magpies (*Pica hudsonia*).

Provisions of the B.C. *Wildlife Act* are reviewed below.

Section 4 provides for the power to designate Wildlife Management Areas as follows:

> "With the consent of the Lieutenant Governor in Council, the minister may, by regulation, designate as a wildlife management

> area land that is under the minister's administration and is not in a park, a conservancy or a recreation area
>
> Despite any other enactment, a person may not use land or resources in a wildlife management area without the written permission of the regional manager."

Section 5 provides for the creation of Critical Wildlife Areas and wildlife sanctuaries as follows:

> "If the minister requires land for habitat for a species of wildlife designated as an endangered species or threatened species, the minister may, by regulation, designate land in a wildlife management area as a critical wildlife area."

Section 6 provides for the designation of species as 'endangered' or 'threatened' as follows:

> 1) "If the Lieutenant Governor in Council considers that a species of wildlife is threatened with imminent extinction throughout all or a significant portion of its range in British Columbia because of the action of humans, the Lieutenant Governor in Council may, by regulation, designate the species as an endangered species.
>
> 2) If the Lieutenant Governor in Council considers that a species of wildlife is likely to become endangered in British Columbia if the factors affecting its vulnerability are not reversed, the Lieutenant Governor in Council may, by regulation, designate the species as a threatened species."

Section 7 states:

> "(1) A person commits an offence if the person
>
> a) alters, damages, or destroys wildlife habitat, or
>
> b) deposits on land or water a substance or manufactured product or by-product
>
> in a manner that is harmful to
>
> (c) wildlife, or
>
> (d) wildlife habitat
>
> in a wildlife management area, except as permitted under section 4 (4) or by the regulations or a permit.
>
> (4) A regional manager may make orders prohibiting a person from:
>
> (a) entering,
>
> (b) cutting, picking, removing, altering, destroying or damaging vegetation in,
>
> (c) disturbing or harassing wildlife in,
>
> (d) releasing or abandoning an animal in, and
>
> (e) allowing an animal to enter

> a wildlife management area, a critical wildlife area or a wildlife sanctuary."

Section 9 states:

> "(1) A person commits an offence if the person disturbs, molests or destroys
>
> (a) a muskrat house or den, except on diked land, or
>
> (b) a beaver house or den or beaver dam."

Section 9(1) does not apply to a licensed trapper, if the action is taken to provide irrigation or drainage under lawful authority for the protection of property, or if the action is authorized by regulation.

Section 11 states that hunting of wildlife is an offence unless the person holds a hunting license or permit

> 8) "Trapping of fur bearing animals is only allowed if the person holds a trapping license
>
> 9) First Nations residing in British Columbia do not require a hunting licence"

Section 30 provides that it is an offence to hunt, take, kill or wound big game while it is swimming.

Section 33 provides that it is an offence to have in one's personal possession live or dead wildlife, except as authorized under a licence or permit or as provided by regulation (not applicable to persons acting under a licence under the *Fur Farm Act* or the *Game Farm Act*).

Section 33.1 provides that it is an offence to intentionally feed or attempt to feed dangerous wildlife, subject to certain exceptions.

Section 34 provides that it is an offence to (except as provided by regulation) possess, molest, take, injure, or destroy:

> (a) a bird or its egg,
>
> (b) the nest of an eagle, peregrine falcon, gyrfalcon, osprey, heron or burrowing owl, or
>
> (c) the nest of a bird not referred to in paragraph (b) when the nest is occupied by a bird or its egg.

14.1.1.5 *Forest Range and Practices Act*

The *Forest and Range Practices Act* (FRPA) and its regulations govern the activities of forest and range licensees in B.C., including requirements for planning, road building, logging, reforestation, and grazing. It took effect on January 31, 2004, and any activities already approved prior to this time under the existing Forest Practices Code may continue and are governed by the *Forest Practices Code of BC Act* and its regulations.

In 2004 the Minister of Water, Land and Air Protection (now the Ministry of Environment) established a category of species at risk by order made under FRPA. This category represents those species that may be affected by forest or range management on Crown

land and are listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). "Identified Wildlife" are predominantly selected from the provincially Red- or Blue-listed wildlife species. An inter-agency committee (comprised of individuals with environment or forestry backgrounds) consults with species experts to determine which of these species should be recommended for designation as Identified Wildlife.

Under the FRPA, the Lieutenant Governor-in-Council may make regulations authorizing the Minister of Environment to establish one or more of the following under Section 149.1 (a):

i. "an area as an ungulate winter range and objectives for the ungulate winter range;

ii. an area as a wildlife habitat area and objectives for the wildlife habitat area;

iii. a general wildlife measure;

iv. categories of wildlife for the purposes of subparagraphs (i) to (iii)"

Wildlife Habitat Areas are managed for selected species and plant communities that have been designated as Identified Wildlife. These areas are mapped and approved by the chief forester and the Deputy Minister of Environment.

General wildlife measures direct what forest and range management practices can occur within a Wildlife Habitat Area. They may restrict forest or range activities during sensitive periods (e.g., the breeding season) to minimize disturbance or may restrict activities entirely within an area to maintain the integrity of the habitat.

14.1.1.6 Federal Policy on Wetland Conservation

In 1991, the Government of Canada adopted the Federal Policy on Wetland Conservation (Government of Canada 1991). The objective of this policy is to "promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions, now and in the future." To achieve this objective, the government has identified goals regarding maintenance of wetland function (including no net loss of wetland functions on all federal lands and waters), enhancement and rehabilitation of wetlands, recognition of wetland function and sustainable wetland management in planning processes, and securement of important wetlands. Strategies to achieve these goals include:

1. Developing public awareness and understanding of wetland resources;
2. Wetland management on federal lands and waters and in other federal programs that can act as an example to other wetland management programs;
3. Promoting wetland conservation in federal protected areas;
4. Enhancing cooperation with provinces, territories and non-government agencies to advance wetland conservation;
5. Conserving wetlands of significance to Canadians;
6. Ensuring a sound scientific basis for wetland conservation policy; and
7. Promoting international actions.

14.1.2 Key Issues and Identification of Potential Effects

Issues, concerns and interests identified during consultation with the public, Aboriginal groups, and government agencies guided the scope of the wildlife resources assessment (see Volume 1 Section 9 Information Distribution and Consultation).

Input from: management considerations described within the Peace Moberly Tract Sustainable Resource Management Plan (SRMP), Fort St. John Land and Resource Management Plan (LRMP), and Dawson Creek LRMP; discussions during the Wildlife Technical Advisory Committee (TAC); and concerns identified in various Traditional Use Studies were also considered. A brief summary of each of these inputs is provided below.

Resource Management Planning

LRMPs and SRMPs are strategic land use plans designed to help stakeholders identify and manage economic opportunities provided by natural resource development, as well as conserve cultural and environmental values. LRMPs are a higher-level plan than SRMPs, encompassing a much larger area and generally taking more resource development/environmental protection into effect. Both plans are meant to provide a long-term plan for Crown land resource development, and are established as a combined effort by private citizens, stakeholders (e.g., industrial sector, environmental groups), government agency representatives, and local Aboriginal groups.

Three specific management plans have been completed that overlap the Project, including the Peace Moberly Tract Draft SRMP (West Moberly and Saulteau First Nations 2006), Dawson Creek LRMP (Dawson Creek LRMP Inter-Agency Planning Team 1999), and Fort St. John LRMP (Fort St. John LRMP Working Group 1997). Species identified for management in these plans include ungulates, grizzly bear (*Ursus arctos*), fur-bearers, trumpeter swans (*Cygnus buccinator*), Red- and Blue-listed songbirds, Red- and Blue-listed plant communities, and berries.

Wildlife Technical Advisory Committee

A summary of the Technical Advisory Committee (TAC) process is provided in Section 9.3 Agency Information Distribution and Consultation in Volume 1 Section 9 Information Distribution and Consultation. Key discussions, issues, and concerns raised by the TAC are summarized in Table 9.3.3 Key TAC Discussions.

Traditional Use Studies

Traditional Land Use Studies (TLUS) were prepared for a number of Aboriginal group communities. These included Blueberry River First Nation Traditional Land Use Study (Bouchard and Kennedy 2011); Duncan's First Nation Ethnohistorical Review (Bouchard and Kennedy 2012a); Horse Lake First Nation Ethnohistorical Overview (Bouchard and Kennedy 2012b); Doig River First Nation, Prophet River First Nation, Halfway River First Nation, and West Moberly First Nation Traditional Land Use Study (Chandler 2012); Saulteau First Nation Culture and Traditions Study (NesooWatchie Resource Management Ltd. 2011), Kelly Lake Métis Settlement Society Aboriginal Traditional Knowledge Assessment (KSDavidson & Associates and KCD Consulting Incorporated 2012), Dene Tha' Traditional Land Use with Respect to BC Hydro's Proposed Site C Dam (Stevenson 2012), and Fort Nelson First Nation Background and Rational for Involvement in the Site C Project (Wolfenden 2012).

Specific issues and concerns raised by the Aboriginal groups within the various reports, as well as the approach used to address the issues, are presented in Table 14.1.

Table 14.1 Aboriginal Key Issues: Wildlife Resources

Key Issues	Approach to Addressing Key Issues
Reservoir creating a barrier to movement for grizzly bear, black bear (*Ursus americanus*), moose (*Alces alces*) snowshoe hare (*Lepus americanus*), and grey wolf (*Canus lupus*).	Effects on movement are considered for large carnivores and ungulates. Snowshoe hare and black bear are not specifically addressed.
Erosion and bank sloughing will impede wildlife movement in and out of the reservoir.	The erosion impact line has been calculated and the potential extent of bank sloughing during operations has been included within the assessment.
Elimination of calving sites for moose, mule deer (*Odocoileus hemionus*), and elk (*Cervus canadensis*) on islands within the Peace River.	Calving sites for ungulates is part of the assessment under habitat alteration and fragmentation.
Decrease in population and loss of habitat and associated hunting areas for white-tailed deer (*Odocoileus virginianus*), mule deer, moose, and woodland caribou (*Rangifer tarandus*).	Effects on ungulate habitats are part of the assessment under habitat alteration and fragmentation.

Key Issues	Approach to Addressing Key Issues
Decrease in population of fur-bearers – specifically, squirrel, rabbit, common muskrat (*Ondatra zibethicus*), American marten (*Martes americana*), fisher (*Martes pennanti*), wolverine (*Gulo gulo*), Canada lynx (*Lynx canadensis*), and American beaver (*Castor canadensis*).	Effects on fisher and beaver are part of the assessment. A detailed assessment of effects on other fur-bearers is not included – rationale provided in Table 14.2.
Loss of rare and important ecosystems for Red- and Blue-listed neo-tropical migrant birds, fur-bearers, wolves.	The loss of suitable habitats is part of the assessment of effects on migratory birds and fur-bearers. General effects on wolves are considered under large carnivores.
Forced relocation and drowning of smaller wildlife with the filling of the reservoir.	Forced relocation and drowning is considered under effects associated with disturbance and displacement, and mortality.
Effects on bats.	Effects on bats are part of the mammal assessment.
Effects on cougars (*Puma concolor*).	Cougar is not part of the assessment – rationale provided in Table 14.2.
Effects on ptarmigan.	Ptarmigan is not part of the assessment – rationale provided in Table 14.2.
Effects on bison (*Bos bison*).	Bison is not part of the assessment – rationale provided in Table 14.2.
Effects on wildlife from the increase in noise and other sensory disturbances, including increased public access.	Effects from noise are considered under effects associated with disturbance and displacement.
Exposure of animals to contaminants, including dust.	The effects of dust are considered within the effects assessment.
Loss of ungulate rutting grounds.	The focus of the assessment on habitat use by ungulates is on winter use.
Loss of lek sites for Sharp-tailed Grouse (*Tympanuchus phasianellus*).	The potential loss of lek sites is included for Sharp-tailed Grouse as part of the assessment under habitat alteration and fragmentation.
Loss of animal den and nesting sites.	The potential loss of nesting and denning sites has been included for a number of species as part of the assessment under habitat alteration and fragmentation.
Destruction of moose mineral licks.	Mineral licks observed were recorded in baseline but are not specifically addressed in the assessment.
Change in water temperatures and ice formation patterns, which may negatively affect wildlife.	Water temperature and ice formation has been reviewed and is considered as part of the assessment.
Relocation of moose, American beavers, ducks, and geese due to a reduction in water levels downstream	The effect of changes to the downstream surface water regime is considered as part of the assessment.
Decrease in water leading to limited new growth, resulting in a reduced amount of moose browse.	A decrease in water is not anticipated. The loss of seasonal moose forage as a result of the Project is considered within the assessment under habitat alteration and fragmentation.
Potential for increased predation of grey wolves on moose, and Canada lynx on American beaver.	Potential mortality risks are considered for both American beaver and moose.
Increase in hunting pressure from other Aboriginal groups on northern Aboriginal territories due to a loss of key ungulate winter ranges.	The loss of designated ungulate winter ranges is part of the assessment.

Not all issues suggested by Aboriginal groups were included as key indicators (Table 14.2). This was because some species had no expected interaction with the Project, they are common across the landscape and a change to the population in the LAA is not expected, or they could be effectively assessed under another key indicator.

Table 14.2 Rationale for the Exclusion of Suggested Species

Species	Rationale for exclusion
Ptarmigan	No interaction with the Project is expected.
Muskrat	Strongly associated with aquatic and riparian habitats. The species shares similar habitat needs with American beaver, which has been selected as a key indicator.
Squirrel	Considered to be abundant and a forested habitat generalist. Resilient to disturbance. The Project is not expected to result in a change in the population in the LAA.
Snowshoe hare	A common species with cyclical population fluctuations (Krebs et al. 2001). Tends to prefer younger forest types for forage and security, which is not limited on the landscape. The Project is not expected to result in a change in the regional population.
American marten	Not as a selective of habitats as fisher, but does have some similar habitat needs. Fisher has been selected as a key indicator.
Wolverine	Individuals are rare or not occurring within much of the LAA. The Project is not expected to have a result in a change in the population in the LAA.
Canada lynx	A species whose population and density is strongly linked to cyclical fluctuations in prey (especially snowshoe hare), see Krebs et al. (2001). Since changes to snowshoe hare are not expected, the same is assumed for Canada lynx.
Bison	No interaction with project is expected.
Caribou	Caribou are not found in the Peace River valley, so they will not be directly affected by the proposed reservoir or dam. Where Project components do occur in recognized caribou herd ranges (e.g., West Pine Quarry), a review of existing data has determined that there will be no direct Project interactions on caribou, and that sites can be operated in such a way as to have no indirect interactions on caribou. The West Pine Quarry has been in operation by the B.C. Ministry of Transportation and Infrastructure since 2001. Operations will expand the existing quarry, but will not encroach upon important habitats noted in recovery planning and activities will continue to follow practices currently used by the B.C. Ministry of Transportation and Infrastructure.
Black bear	A common species with high resilience. It uses a wide variety of habitats. Bear-human interactions are addressed under grizzly bear, which has been selected as a key indicator.
Cougar	There have been few reported observations by landowners, and Conservation Officers have not dealt with the species within the Peace region between 2003 and 2012 (based on the B.C. Wild Predator Loss Control and Compensation Program). The species was not observed during any study since detailed fieldwork began in 2005. No interaction within the LAA is anticipated because individuals rarely occur within the LAA.

14.1.2.1 Project Interactions

Potential project interactions with wildlife resources are summarized in Volume 2 Appendix A Project Interactions Matrix, Table 2. As defined in Volume 2 Section 10 Effects Assessment Methodology, a rank of “2” was given where interactions may result in an adverse effect and the nature of the effect and/or the effectiveness of mitigation measures are uncertain. These interactions were taken forward through the effects assessment.

Project interactions with a ranking of “2” are summarized in Table 14.3. The assessment was completed for both the construction and operational phases of the Project. Since many of the Project activities are similar across all Project components, Table 14.3 is an abbreviated version of Table 2 provided in Volume 2 Appendix A Project Interactions Matrix.

Section 12.2.4 of the EIS Guidelines states that the assessment of potential adverse effects on the VC will take into account the potential for the Project to result in changes to the following key aspects:

- Permanent and temporary habitat alteration and fragmentation
- Disturbance and/ or displacement
- Potential for direct and indirect mortality to individuals

Table 14.3 Interactions of the Project With Wildlife Resources

Project Activities and Physical Works	Key Aspects		
	Habitat Alteration and Fragmentation	Disturbance or Displacement	Mortality
Construction			
Dam, Generating Station and Spillways			
Site clearing and preparation	✓	✓	✓
Temporary and permanent access roads	✓	✓	✓
Waste treatment and management facilities	✓		
Installation and operation of temporary facilities		✓	
Hazardous materials storage and refueling sites	✓		✓
Truck washing sites	✓		
Aggregate and filter processing plants		✓	
Relocation of surplus excess material	✓	✓	✓
Temporary construction access bridge across the Peace	✓	✓	✓
Transportation of construction materials and supplies		✓	✓
Sand and gravel source pits	✓	✓	✓
Stage 1 and 2 channelization and diversion works	✓	✓	✓
Existing infrastructure relocation	✓	✓	✓
Quarried and Excavated Material Source Development			
Site preparation, earthworks and operations	✓	✓	✓
85th Avenue conveyor belt		✓	
Construction Access Road Development			
Site preparation and earthworks, drainage, railway construction	✓	✓	✓
Highway 29 Realignment			
Realign highway sections	✓	✓	✓
Worker Accommodation			
Supply and transportation of goods and services for the camp		✓	✓
Temporary accommodation		✓	✓
Reservoir			
Existing infrastructure inventory, protection and/or relocation	✓	✓	✓
Hudson's Hope shoreline protection	✓	✓	✓
Road upgrade and winter road construction	✓	✓	✓
Clearing of vegetation and timber	✓	✓	✓
Transport of merchantable timber		✓	✓

Project Activities and Physical Works	Key Aspects		
	Habitat Alteration and Fragmentation	Disturbance or Displacement	Mortality
Post-harvest terrestrial debris management	✓	✓	✓
Access deactivation and reclamation	✓	✓	✓
Aquatic debris management during inundation	✓	✓	
Water management during diversion confinement, reservoir filling and commissioning	✓	✓	✓
Transmission Line			
Clearing and preparation	✓	✓	✓
Access construction and right-of-way improvement	✓	✓	✓
Tower installation		✓	
Conductor stringing		✓	
Construction site decommissioning and reclamation	✓	✓	✓
Upgrades to Peace Canyon substation	✓	✓	✓
Site C substation installation		✓	
Operations			
Dam, Generating Station, and Spillways			
Operations includes reservoir and downstream water management	✓	✓	✓
Maintenance of powerhouse and substation		✓	
Reservoir			
Debris management	✓	✓	✓
Hudson's Hope berm maintenance	✓	✓	✓
Transmission Line			
Right-of-way vegetation maintenance	✓	✓	✓
Maintenance of overhead structures		✓	
Maintenance of access roads	✓	✓	✓

14.1.3 Standard Mitigation Measures and Effects Addressed

A rank of "0" means there is no interaction between the Project components and the VC. Volume 2 Appendix A Project Interactions Matrix, Table 2 provides a rationale for why some activities were ranked "0". These were not carried forward through the effects assessment.

A rank of "1" means that an interaction would occur but that it is well understood and can be avoided or mitigated through the application of standard mitigation measures and would be negligible. No Project activities were assigned a ranking of "1".

14.1.4 Selection of Key Indicators

The EIS Guidelines (Section 12.1) state that the "assessment of potential adverse effects on wildlife resources will be based on the following key species groups: butterflies and dragonflies; amphibians and reptiles; migratory birds; non-migratory game birds; raptors; bats; furbearers; ungulates; and large carnivores." The key species groups have been further divided into key indicators, including down to the species level in some instances, following Section 12.2.3 of the EIS guidelines. The list of key indicators is outlined in Table 14.4.

Table 14.4 Key Indicators for Wildlife Resources

Key species group	Key Indicators	Rationale for Selection of the Key Indicators
Butterflies and dragonflies	Butterflies and dragonflies	Provincial species at risk
Amphibians and reptiles	Western toad	Federal and provincial species at risk
	Garter snakes	Regional species of interest
Migratory birds	Songbirds – with a focus on provincially and federally listed species: Bay-breasted Warbler, Black-throated Green Warbler, Canada Warbler, Cape May Warbler, Connecticut Warbler, Rusty Blackbird, Olive-sided Flycatcher	Federal and provincial species at risk
		Migratory Bird Convention Act
	Waterfowl and shorebirds: including trumpeter swan	Provincial species at risk
		Migratory Bird Convention Act
	Marsh birds – with a focus on Yellow Rail, American Bittern, Nelson's Sparrow and Le Conte's Sparrow	Federal and provincial species at risk
		Migratory Bird Convention Act
	Woodpeckers	Species of regional interest
		Migratory Bird Convention Act
	Common Nighthawk	Federal species at risk
		Migratory Bird Convention Act
	Swallows	Provincial species at risk (Barn Swallow)
		Migratory Bird Convention Act
Non-migratory game birds	Sharp-tailed and Ruffed Grouse	Species of regional management concern
		Species of interest to Aboriginal groups
Raptors	Bald Eagle	Nests protected year-round under Section 34 of the B.C. *Wildlife Act*
	Northern Goshawk	Regional species of interest
	Broad-winged Hawk	Provincial species at risk
	Northern Harrier	Regional species of interest
	Owls – with a focus on Short-eared Owl, Great Horned Owl, Great Gray Owl, Boreal Owl, and Northern Saw-whet Owl	Short-eared Owl is a federal and provincial species at risk
		Regional species of interest
Bats	Bats	Some species at risk provincially and federally
Fur-bearers	Fisher and American beaver	Harvested species
		Fisher is a provincial species at risk
		Species of interest to Aboriginal groups
Ungulates	Ungulates – with a focus on moose, elk, mule deer, and white-tailed deer	Regional species of management concern
		Harvested species
		Species of interest to Aboriginal groups

Key species group	Key Indicators	Rationale for Selection of the Key Indicators
Large carnivores	Grey wolf	Species of regional management concern
		Species of public interest
		Species of interest to Aboriginal groups
	Grizzly bear	Provincial species at risk
		Species of public interest
		Harvested species
		Species of interest to Aboriginal groups

14.1.5 Spatial and Temporal Boundaries

14.1.5.1 Spatial Boundaries

The spatial boundaries used in the assessment include the:

- **Local Assessment Area (LAA):** the area within which the potential adverse effects of the Project are assessed. The LAA encompasses the Project activity zone, buffered by an additional 1,000 m. This buffer is larger than was suggested in Table 11.2 of the EIS Guidelines. A 1,000 m buffer was selected to allow adequate characterization of the terrestrial environment surrounding the Project activity zone, and extends far enough to include all potential direct and indirect effects at all construction sites and during operations. This includes new roads, roads requiring upgrades, quarries, the dam site, and the transmission line. For the proposed reservoir, the erosion impact line has a 1,000 m buffer.

  The LAA also extends downstream from the dam to the Alberta border, and includes a 1,000 m buffer on both the south and north banks of the Peace River (Figure 14.1). This considers potential effects on riparian areas that could be affected by reductions in the magnitude of peak flows, and more frequent high and low flows from the dam downstream to the Pine River confluence (see Section 11.4 Surface Water Regime in Volume 2 Section 11 Environmental Background).

- **Regional Assessment Area (RAA):** the area within which projects and activities – the residual effects of which may combine with residual effects of the Project – are identified and taken into account in the cumulative effects assessment. The proposed dam, reservoir, transmission line, Highway 29 realignment, temporary access roads, and quarries occur within five Wildlife Management Units – designated 7-31, 7-32, 7-33, 7-34, and 7-35 (Figure 14.1). The Wildlife Management Unit boundaries provide a larger RAA boundary than what was suggested in Table 11.2 of the EIS Guidelines. The updated boundary includes most of the Peace Lowlands ecosection and incorporates all Project components and activities.

14.1.5.2 Temporal Boundaries

The temporal boundaries of the assessment include short- and moderate-term (construction phase; Year 0-8) and long-term (operations phase; begin in Year 8 and may continue throughout the life of the Project) time frames and seasons, or life history stages of key indicators. In some cases, the effects assessment is limited to one Project

phase, due to the timing and duration of the activities causing the effect. Potential effects on some species may be more pronounced, depending on the season or life history stages. For example, potential effects on wetlands are more of a concern for western toads during their breeding season, and migrating songbirds typically are only present in the Project area between May and August.

14.2 Baseline Conditions

Baseline conditions were characterized using information from existing literature and field studies that were conducted from 2005 to 2012. The scope of the work was to collect baseline data of wildlife species presence, distribution, and abundance. Taxa identified in the scope of these studies included butterflies and dragonflies, amphibians and reptiles, migratory birds, non-migratory game birds, raptors, bats, fur-bearers, ungulates, and large carnivores.

The following section provides a summary of the baseline conditions for wildlife resources. This section is supported by more detailed information presented in Volume 2 Appendix R Terrestrial Vegetation and Wildlife Report.

14.2.1 Butterflies and Dragonflies

There are 20 Red- or Blue-listed butterfly taxa that potentially occur in the LAA. There are also two provincially Blue-listed damselfly species and one Blue-listed dragonfly.

In the two years – 2006 and 2008 – of butterfly sampling, 285 sites including replicates were surveyed, and approximately 3,300 specimens were collected. Sixty-five taxa were identified, of which 14 were Red- or Blue-listed.

A total of 155 dragonfly and damselfly specimens were collected in aquatic habitats in the Peace River valley in 2008, and approximately 2,500 specimens of aquatic larvae and exuviae (cast exoskeletons) were collected in 2012. Of the total collected, 28 species in nine genera and five families were identified, including the collection of a Blue-listed prairie bluet (*Coenagrion angulatum*).

Using the area of wetlands in the LAA as a surrogate for potentially suitable dragonfly and damselfly breeding habitat, approximately 4,300 ha occurs within the LAA.

Habitat suitability modelling completed for 10 species of butterflies identified a wide range of potential suitable habitat within the LAA – between 3,474 ha and 26,644 ha, depending on the species.

For a detailed description of the baseline work completed for butterflies and dragonflies, see Part 2 of Volume 2 Appendix R Terrestrial Vegetation and Wildlife Report.

14.2.2 Amphibians and Reptiles

Seven amphibian and reptile species are known to occur in the LAA: boreal chorus frog (*Pseudacris maculata*), Columbia spotted frog (*Rana luteiventris),* long-toed salamander (*Ambystoma macrodactylum),* wood frog (*Lithobates sylvaticus*), western toad, common garter snake – red-sided subspecies (*Thamnophis sirtalis parietalis*), and the terrestrial garter snake (*T. elegans*). Of these seven species, only the western toad is provincially Blue-listed and listed federally as a species of special concern under Schedule 1 of the *Species at Risk Act*.

All five amphibian species were detected during amphibian surveys conducted between 2006 and 2012. Western toads and wood frogs were found in all life stages – adults, juveniles, tadpoles, and eggs. Columbia spotted frogs and boreal chorus frogs were observed as adults and egg clusters. Only one adult long-toed salamander was observed. Western toads were detected at 27 different sites.

Both species of garter snake were detected. Four hibernacula were confirmed in the LAA – two at Bear Flat, one at Tea Creek, and one west of the Clayhurst Bridge. The sites were crevices on steep, warm aspect cliffs or rock outcrops and are outside the proposed reservoir. The hibernacula are small, providing for individuals, rather than groups.

Habitat suitability modelling was completed for western toad breeding habitat and garter snake hibernation habitats. Within the LAA, 13,864 ha of western toad breeding habitat, and 4,084 ha of suitable garter snake hibernation habitat were identified.

For a detailed description of the baseline work completed for amphibians and snakes, see Part 3 of Volume 2 Appendix R Terrestrial Vegetation and Wildlife Report.

14.2.3 Migratory Birds

Migratory bird studies were completed in 2006, 2008, 2011, and 2012 for a variety of bird species and species groups, including: songbirds, swallows, waterfowl and shorebirds, marsh birds, woodpeckers, and Common Nighthawk.

Songbirds include the orders Passeriformes (passerines), Apodiformes (hummingbirds and swifts), Columbiformes (doves and pigeons), and Coraciiformes (kingfishers). There are seven Red- or Blue-listed songbird species known to occur within the LAA. Three of these species – Canada Warbler (*Cardellina canadensis*), Olive-sided Flycatcher (*Contopus cooperi*), and Rusty Blackbird (*Euphagus carolinus*) – are SARA listed. The Canada Warbler and Olive-sided Flycatcher are Schedule 1 Threatened, and the Rusty Blackbird is Schedule 1 Special Concern.

Breeding bird point-counts were completed and resulted in a total of 169 species and 39,635 bird observations recorded. Counts of rare species for all survey years included six Bay-Breasted Warblers (*Setophaga castanea*), 621 Black-throated Green Warblers (*Setophaga virens*), 294 Canada Warblers, six Cape May Warblers (*Setophaga tigrina*), 73 Connecticut Warblers (*Oporornis agilis*), 49 Olive-sided Flycatchers, and 27 Rusty Blackbirds.

Fall migration encounter transects were completed in the fall of 2012, and a total of 129 avian species were detected, with a total count of 9,068 birds. All five ~~seven~~ rare species of warblers, as well as rare Olive-sided Flycatchers and Rusty Blackbirds, were documented during the fall surveys.

From the habitat suitability modelling for rare species, the amounts of available suitable habitat identified within the LAA were:

- Bay-breasted Warbler – Red-listed: 15,640 ha
- Black-throated Green Warbler – Blue-listed: 34,776 ha
- Canada Warbler – Blue-listed: 12,033 ha
- Cape May Warbler – Red-listed: 9,749 ha
- Connecticut Warbler – Red-listed: 27,035 ha

- Rusty Blackbird – Blue-listed: 1,698 ha

Habitat modelling for Olive-sided Flycatcher was not completed, as stand-level attributes – e.g., snag density, tree values in a recent cut-block – are difficult to map, and the confidence in the model would be low. ~~A qualitative assessment in the potential change was considered.~~ The species is thought to be associated with burns and with muskeg and wetlands (COSEWIC 2007) but otherwise occupies a range of forest types (Campbell et al. 1997). The species was detected at relatively low numbers in a variety of habitat types including riparian areas and valley bottom forest along the Peace River, wetland edges on the plateau near the transmission line, and river islands.

Results from swallow nest counts and point-count surveys documented a total of 39 single nests and 89 colonies, representing Bank Swallow (*Riparia riparia*), Northern Rough-winged Swallow (*Stelgidopteryx serripennis*), Cliff Swallow (*Petrochelidon pyrrhonota*), and Violet-green Swallow (*Tachycineta thalassina*). Large Bank Swallow colonies were observed near the Moberly River and Bear Flat, and large colonies of Cliff Swallows were observed near the Peace Canyon Dam.

Cliff Swallows were the most common species observed with 958 detections, followed by Bank Swallows (n = 803) and Violet-green Swallows (n = 648).

Encounter transects were completed for waterfowl and shorebirds in 2006 and 2008, and resulted in observations of 59 species of waterfowl using the Peace River and tributaries – 35 species were observed in backchannels, 24 species in wetlands, and 34 species observed on lakes. Red- and Blue-listed species detected during surveys included Cackling Goose (*Branta hutchinsii*), Caspian Tern (*Hydroprogne caspia*), California Gull (*Larus californicus*), Double-crested Cormorant (*Phalacrocorax auritus*), Great Blue Heron (*Ardea herodias* ssp. *herodias*), Long-tailed Duck (*Clangula hyemalis*), Surf Scoter (*Melanitta perspicillata*), and Upland Sandpiper (*Bartramia longicauda*).

Specific to the Peace River, 13 species of waterfowl were detected only along the river. These included Arctic Tern (*Sterna paradisaea*), Black-bellied Plover (*Pluvialis squatarola*), California Gull, Caspian Tern, Common Tern (*Sterna hirundo*), Greater White-fronted Goose (*Anser albifrons*), Harlequin Duck (*Histrionicus histrionicus*), Mew Gull (*Laruscanus*), Pacific Loon (*Gaviapacifica*), Ring-billed Gull (*Larus delawarensis*), Red-throated Loon (*Gavia stellata*), Sandhill Crane (*Grus canadensis*), and Snow Goose (*Chen caerulescens*).

In 2013, additional spring waterfowl and shorebird surveys were completed on the Peace River from the Peace Canyon Dam to the Alberta border in March, April and June. Five species were observed in March (Bufflehead, Canada Goose, Common Goldeneye, Common Merganser, and Mallard). More species (17) and a greater number of birds were recorded in April. June surveys had similar number of species compared to April but fewer birds overall. A total of 69 Trumpeter Swans were counted in April and the largest concentration of Trumpeter Swans was observed slightly upstream of the Peace River confluence with the Halfway River.

Four bird species are identified as marsh birds, including two from the Order Passeriformes (Le Conte's Sparrow and Nelson's Sparrow) and one from each of the Order Gruiformes (Yellow Rail) and Order Pelecaniformes (American Bittern).

Counts from call-playback surveys and point-count stations resulted in detections of 29 Le Conte's Sparrows, 13 Nelson's Sparrows, and 33 Yellow Rails. No American Bittern were detected.

The species model for American Bittern identified 5,395 ha of low-suitability habitat within the LAA. Modelling for the other three species within the LAA identified:

- 4,534 ha of suitable habitat for Le Conte's Sparrow
- 4,534 ha of suitable habitat for Nelson's Sparrow
- 2,043 ha of suitable habitat for Yellow Rail

Call-playback surveys and nest searches were completed for seven woodpecker species that occur in the Peace Region. All seven species (American Three-toed Woodpecker, Black-backed Woodpecker, Downy Woodpecker, Hairy Woodpecker, Northern Flicker, Pileated Woodpecker, and Yellow-bellied sapsucker) were detected during targeted surveys. A total count of 1,021 woodpeckers was recorded, with 998 identified to species. Sixteen woodpecker nests were observed during woodpecker surveys,

including one Downy Woodpecker (*Picoides pubescens*), two American Three-toed Woodpecker (*Picoides dorsalis*), and 13 Yellow-bellied Sapsucker (*Sphyrapicus varius*).

Three species models were completed to act as surrogates for all seven species. The species model for American Three-toed Woodpecker identified 21,581 ha of suitable habitat within the LAA; the Pileated Woodpecker (*Dryocopus pileatus*) model identified 14,463 ha of suitable habitat; and the species model for Yellow-bellied Sapsucker identified 40,274 ha of habitat suitable within the LAA.

The Common Nighthawk is federally listed as Threatened and is on Schedule 1 of the *Species at Risk Act*. A total of 69 Common Nighthawk were recorded from call-playback surveys. The species model prepared for Common Nighthawk nesting habitat identified 14,462 ha of suitable habitat within the LAA.

For a detailed description of the baseline work completed for migratory birds see Part 4 of Volume 2 Appendix R Terrestrial Wildlife and Vegetation Effects Assessment. ~~Vegetation and Wildlife Report.~~

14.2.4 Non-Migratory Game Birds

Species-specific surveys for Ruffed Grouse were completed in 2011, with a total of 69 Ruffed Grouse detections recorded. An additional 275 detections of Ruffed Grouse were observed during breeding bird point-counts, completed over multiple years. The model for Ruffed Grouse identified 52,659 ha of suitable habitat within the LAA.

Information on 21 Sharp-tailed Grouse leks documented by the B.C. Ministry of Environment (BCMOE) was obtained and assessed. An additional 34 point-count stations within Area E were completed for Sharp-tailed Grouse. One lek was identified during point-count surveys at Area E and a total of eight Sharp-tailed Grouse were observed. Additional incidental observations during surveys over multiple years for other taxa resulted in 72 Sharp-tailed Grouse detections.

Two habitat suitability models for Sharp-tailed Grouse were completed – during the growing season (June through September) and the winter season (October through March) – as Sharp-tails are partially migratory and some may shift between summer and winter ranges. The habitat models identified 22,920 ha of suitable habitat during the growing season and 9,697 ha of suitable habitat during the winter season in the LAA.

For a detailed description of the baseline work completed for non-migratory game birds, see Part 5 of Volume 2 Appendix R Terrestrial Vegetation and Wildlife Report.

14.2.5 Raptors

Raptor studies were completed for Bald Eagle, Broad-winged Hawk, Northern Goshawk, Northern Harrier, and five species of owls: Great Horned, Great Gray, Boreal, Northern Saw-whet, and Short-eared Owls.

Raptor survey work included aerial nest surveys for Bald Eagles. The most recent surveys in 2011 identified 59 active and inactive nests, 53 of which were along the Peace River. Balsam poplar (*Populus balsamifera*) was selected for nesting by Bald Eagles the majority – 85% – of the time.

Standwatches, call-playback surveys, and nest searches were completed for Broad-winged Hawk. A total of nine Broad-winged Hawk detections were made, all during call-playback surveys. Four Broad-winged Hawk nests were observed. All were

platform stick-nests. The species model prepared for Broad-winged Hawk identified 25,927 ha of suitable nesting habitat within the LAA.

Call-playback surveys and nest searches were completed for Northern Goshawk**.** Eleven detections were recorded, along with three confirmed active nests and one possible nest. The species model for Northern Goshawk identified 38,820 ha of suitable nesting habitat within the LAA.

Encounter transects, standwatches, and nest surveys completed for Northern Harrier resulted in a total of 19 detections. No nests were documented. The habitat model prepared for the Northern Harrier identified 13,105 ha of suitable nesting habitat within the LAA.

Call-playback transects were completed for Boreal Owl, Great Gray Owl, Great Horned Owl, and Northern Saw-whet Owl. A total of 27 observations of Boreal Owl, 102 observations of Great Gray Owl, 267 of Great Horned Owl, and 319 of Northern Saw-whet Owl were made. Nest searches for Boreal Owl, Great Gray Owl, and Great Horned Owl did not locate any nests.

Twelve detections of Short-eared Owl were recorded during targeted encounter transects in one of the three years that surveys were completed.

Habitat suitability modelling identified a total amount of suitable habitat within the LAA of:

- 16,010 ha for Boreal Owl
- 16,207 ha for Great Gray Owl
- 15,257 ha for Great Horned Owl
- 12,917 ha for Northern Saw-whet Owl
- 14,156 ha for Short-eared Owl

For a detailed description of the baseline work completed for raptors, see Part 6 of Volume 2 Appendix R Terrestrial Vegetation and Wildlife Report.

14.2.6 Bats

Bat surveys – including mist-net capture surveys, radio-telemetry and acoustic surveys with bat detectors – were conducted in order to document the bat species present and their use of roosting habitat. A total of 189 bats of at least six species were captured with an overall capture success of 0.0102 bats/m^2-hr or 0.471 bats/net-night. Species captured included little brown myotis (*Myotis lucifugus*), a long-eared myotis complex, long-legged myotis (*Myotis volans*), big brown bat (*Eptesicusfuscus*), silver-haired bat (*Lasionycteris noctivagans*), and hoary bat (*Lasiuruscinereus*). All captured species are breeding in the LAA. One additional species – the Red-listed eastern red bat (*Lasiurus borealis*) – was detected acoustically, but not captured.

The long-eared myotis complex includes both the Blue-listed northern myotis (*Myotis septentrionalis*) and the Yellow-listed long-eared myotis (*Myotis evotis*), as these two species are very difficult to distinguish from external characteristics. All remaining species captured are provincially Yellow-listed. Little brown myotis and northern myotis have both received emergency listings as Endangered by COSEWIC due to the impacts

of a fungal disease in eastern Canada. At the time of report preparation, December 2012, the two species had not been included on SARA.

Thirty-four bats were radio-tagged and 56 roosts were identified, including 46 within live trees or snags, six within cutbanks, and four within building structures. Bats most frequently used Balsam poplar–Spruce-Red-osier dogwood floodplain habitats (site series Fm02), in structural stages 3 (shrub) through 6 (mature) for day roosts. Radio-tagged bats of all species that roosted in trees were most often relocated in young to mature forest. Bats found roosting in shrub and pole-sapling forest were using remnant balsam poplar snags.

Bat detectors recorded very high levels of bat activity in late summer and early fall at a number of cliff sites within the Peace River valley, including cliffs at Tea Creek, Bear Flat, and Alwin Holland Municipal Park. Recorded activity at these sites indicates the cliffs are used as winter hibernacula, growing season roost sites, and fall swarming sites. Winter use appears to be big brown bats, based on limited capture data.

Detectors deployed on Portage Mountain in 2012 recorded the Blue-listed northern myotis, little brown myotis, and either big brown bat or silver-haired bat. The pattern of activity at this site is consistent with bats using the area for hibernation.

Habitat suitability modelling for bats identified 31,451 ha of suitable foraging habitat and 33,759 ha of reproducing habitat within the LAA.

For a detailed description of the baseline work completed for bats, see Part 7 of Volume 2 Appendix R Terrestrial Vegetation and Wildlife Report.

14.2.7 Fur-Bearers

14.2.7.1 Beaver

Low-level aerial reconnaissance surveys and surveys by boat were conducted along the Peace River in 2005 and 2011. Aerial surveys flown in 2005 recorded 67 active and 61 inactive lodges on the Peace River between the Moberly River and Hudson's Hope, and 75 active and 52 inactive lodges downstream of the Moberly River to the Alberta border. These observations were used to estimate the beaver population to be 335 animals upstream and 375 animals downstream, based on five beaver per active lodge.

Surveys in 2011 located 59 active and 31 inactive beaver lodges on the Peace River between the Moberly River and Hudson's Hope. An additional 53 active and 16 inactive lodges were recorded downstream of the Moberly River to the Alberta border. A follow-up boat survey, conducted after the aerial survey, recorded an additional 10 active and six inactive lodges downstream of the Moberly River not readily confirmed during the aerial survey, resulting in population estimates of 295 animals upstream and 315 animals downstream, based on five beaver per active lodge.

14.2.7.2 Fisher

Baseline surveys were undertaken to determine the size and orientation of the resident fisher home ranges, to characterize habitat use (particularly denning and resting habitat), to estimate the number of fishers in the Peace River valley and surrounding areas, to determine the population structure and persistence, and to estimate the density and

distribution of den trees within the Peace River valley and surrounding area. Live-capture, subsequent ground- and aerial-based radio-telemetry, genetic analysis of hair samples, and habitat transects identifying suitable denning sites were completed.

Live trapping for radio-telemetry was completed in winter 2010/2011 and winter 2011/2012. A total of 7,352 trap nights – each night that a trap remained open and able to catch an animal – at 489 different sites resulted in 52 captures of 16 individual fishers.

Despite the greater effort and apparently larger amount of suitable habitat south of the Peace River, more fishers were captured on the north side of the river, with 11 captures on the north side and five on the south. Density estimates varied by year and between the two study areas – north and south of the Peace River. The north study area averaged 7.7 fishers/1,000 km^2 over both years, and the south study area averaged 2.6 fishers/1,000 km^2.

A total of 463 radio-telemetry locations were used to determine the home range analysis using two methods: 95% fixed kernel and 100% minimum convex polygon. Based on the 95% fixed kernel method, aggregate home ranges for seven radio-tagged fishers averaged 36.3 km^2 for females and 469.1 km^2 for males. Home ranges of resident fishers were sporadic and clumped across landscape on the south side of the Peace River; overlap was common among the study animals on the north side. Three fishers – one female and two males – crossed the Peace River at least once.

Hair samples were obtained from collected bait stations, captured animals, and fishers taken by trappers. In total, 519 hair samples were collected; 259 samples had sufficient deoxyribonucleic acid (DNA) for extraction. Results indicate that the animals on the north and south sides of the Peace River form one continuous population.

A total of 114 habitat plots were completed in 2011 and 2012. The density of trees with attributes important to fishers was similar between used and unused sites. Five female fishers were tracked to 11 reproductive dens on 37 occasions. All dens were found in balsam poplar (n = 5) or trembling aspen (n = 6) trees.

Stratified sampling for identifying potential cavity-bearing trees was conducted in 2009 and 2011. Twenty different combinations of ecosystem unit and structural stage were sampled, with a total of 162 suitable maternal den trees tallied in 134 km of fixed-area transects. These trees were highest in density in moist mature habitats, with 90% balsam poplar.

Habitat suitability based on tree density was calculated for fishers. An estimated 14,143 ha of suitable habitat is available within the LAA.

For a detailed description of the baseline work completed for fur-bearers, see Part 7 of Volume 2 Appendix R Terrestrial Vegetation and Wildlife Report.

14.2.8 Ungulates

Between 2010 and 2011, a total of 81 individual ungulates were captured, including 20 moose, 23 elk, and 38 mule deer. The provincial government provided data on 10 white-tailed deer tracked using radio-collars from January 2006 to March 2007. For ungulates caught in the first year – excluding mortalities – moose were monitored for an average of 766 days, elk for an average of 783 days, and mule deer for an average of 765 days. Ungulates caught and monitored in the second year averaged 331 days. The white-tailed deer data set indicated an average monitoring period of 328 days. The total

number of locations recorded was 94,336 for moose, 93,867 for elk, 68,730 for mule deer, and 12,428 for white-tailed deer.

Home range sizes averaged 37 km^2 for moose cows and 68 km^2 for bulls; 120 km^2 for elk cows and 506 km^2 for bulls; and 18 km^2 for white-tailed deer. All were classified as non-migratory. Mule deer were classified as non-migratory, short-movement individuals, and long-migration individuals. Average home range size for non-migratory individuals was 15 km^2 for does and 20 km^2 for bucks, 69 km^2 for short-movement does, and 147 km^2 for the one short movement buck, and 526 km^2 for long-migration does and 638 km^2 for bucks. All species crossed the Peace River; only a few crossings were recorded during the winter season by elk or mule deer.

A total of 90 potential birthing sites – 19 within the Peace River valley – were identified and visited between 2010 and 2011. Of the 90 potential sites, equal numbers of sites were suspected to be moose or elk (n = 38 each) and 14 were suspected to be mule deer birthing sites. Habitat types observed at birthing sites were highly variable. The majority of birthing sites were located in deciduous-dominated seral units – 31 ap:At, 11 in ac:Ac, and six in Balsam poplar –White spruce/Mountain alder–red-osier dogwood – Fm02. Of the 19 birthing sites identified in the Peace River valley, three sites – two moose and one mule deer – were identified on islands in the Peace River completely surrounded by flowing water. In general, moose sites were mostly on the plateau, elk favoured valley slopes, and mule deer used the plateau, slopes, and riparian habitats equally.

Habitat use by moose was within the mesic deciduous forest most – 30 to 40% – of the time. Other forested habitats were used at similar rates in proportion to their availability. Moist shrublands were selected year-round; moist coniferous and deciduous forest showed increased use in fall and winter. Riparian habitats were used in proportion to their availability in summer and fall, with increased selection in winter and spring. Anthropogenic habitats, cultivated fields, and open water were avoided year-round. Bulls and cows showed similar habitat use patterns, and few differences were noted between day and night periods.

Elk spent most – 20 to 40% – of their time in the flat mesic deciduous forest. Habitat selection was most evident in winter, when elk increased use of moist deciduous and coniferous forests, riparian forests, and shrublands on warm aspects. Elk avoided anthropogenic habitats and open water year-round, although use of cultivated fields at night increased in fall and winter, compared to daytime. This shift coincided with the hunting season.

Habitat use by buck and doe mule deer was similar for most categories, except does tended to use riparian habitat more than bucks. Mesic broadleaf forest and cultivated fields received the highest use by mule deer in all seasons, and accounted for 40 to 50% of all locations. These two habitats were also the most common habitats available within the mule deer composite home range, at 55% of the area.

Although white-tailed deer spent most time in mesic deciduous forests and shrublands, they only had a clear preference for moist deciduous forests.

All ungulates captured upstream of the proposed dam site were classified based on the proportion of time they spent in the proposed reservoir area. Of the study animals, few – two moose and four mule deer – spent the majority of their time in the proposed reservoir area, most upstream moose (11 of 15) used the proposed reservoir area more

than 10% of the time, four of the 21 elk were in the proposed reservoir area greater than 10% of the time, and 16 of 24 mule deer and one of nine white-tailed deer used the proposed reservoir area more than 10% of the time.

Aerial censuses of moose, elk, and mule deer were completed using stratified block counts in 2006, 2009, and 2011 and compared to surveys completed in 1991. The survey area included the Peace River valley and adjacent slopes from Alberta to Hudson's Hope, although the 1991 survey only included blocks upstream of the proposed dam site. The 2011 estimates within the Peace River valley are 900 moose, 1,100 elk, and 3,500 mule deer. Moose numbers have been relatively stable, although 2011 was the highest count of the four surveys. Elk numbers have been steadily increasing. Mule deer numbers were highest in 1991 and – although appearing stable in recent counts – the population was believed to have dropped following the severe winter of 2007. The 2009 and 2011 counts suggest that the population has recovered.

Based on ungulate use during the collaring study, winter habitat use was identified for the four ungulate species. The amount of suitable wintering habitat in the LAA is:

- 75,603 ha for moose
- 71,871 ha for elk
- 27,901 ha for mule deer
- 8,617 ha for white-tailed deer

Portions of four Ungulate Winter Ranges are present within the LAA – SPE-001, 003, 014, and 025 – accounting for 2,578 ha of habitat.

For a detailed description of the baseline work completed for ungulates, see Part 7 of Volume 2 Appendix R Terrestrial Vegetation and Wildlife Report.

14.2.9 Large Carnivores

Habitat values for wolves are dependent on a good supply of ungulate prey, combined with low amounts of human disturbance. Habitats with low road density, little agricultural land, low human presence, and a component of coniferous forest tend to be the most suitable for wolves (reviewed in Milakovic 2008). The threshold level of road density for wolves to persist has been cited as 0.58 km/km^2 (Mech et al. 1988; Thiel 1985), although wolves may use areas with higher road densities if they are adjacent to large roadless areas (Mech 1989).

Mean annual home range sizes of wolves in the mostly undisturbed Besa-Prophet area, north of the Peace River valley and west of Fort Nelson, were 801 km^2 (Milakovic 2008) and varied based on the proportion of dense conifer stands – low productivity ungulate habitat – within the range. Home range size is positively correlated with pack size, but the factors controlling pack size are not well understood (reviewed in Paquet and Carbyn 2003).

Physical and psychological barriers to wolf movement include areas of dense human settlement and linear corridors such as power lines, highways, seismic lines, railways, and gas lines (Paquet and Carbyn 2003). Mortality risks to wolves from deliberate, accidental or incidental killing by people increase greatly in proximity to such features.

The BCMOE estimates that 30 wolves were killed by hunters in 2010 in MU-7-32, which includes the lower reaches of the Moberly River and a portion of the south bank of the Peace River (B.C. Ministry of Environment unpubl. data). An additional 18 animals were estimated killed in MU7-33, which extends from the Blueberry River east to the Alberta border, along both sides of the Peace River, south to Dawson Creek. As a result of predator control actions in the Peace region, a total of 165 wolves were killed between 2003 and 2012 (B.C. Ministry of Environment unpubl. data).

At present, there is no closed season for hunting or trapping wolves below 1,100 m elevation in the Management Units bordering the Peace River (B.C. Ministry of Forests, Lands and Natural Resource Operations 2012a). The provincial government has recently released a draft wolf management plan (B.C. Ministry of Forests, Lands and Natural Resource Operations 2012b). It is reported that wolves are expanding their range across the province and are returning to areas where they were once extirpated. The plan includes provisions for wolf control to protect domestic stock or species at risk, but not for the purposes of increasing ungulate populations for human harvest. The Province is considering eliminating the bag limit for wolves in the Peace region.

The role of wolf predation in the regulation of ungulate populations has been studied frequently (Jones and Mason 1983; Seip 1992; Van Ballenberghe and Ballard 1994; Allison 1998; Peterson 1988; Garrott et al. 2007; Hebblewhite et al. 2010; Griffin et al. 2011), but remains little understood (Gese and Knowlton 2001; Peek et al. 2012). A recent review of long-term data from Yellowstone, Banff National Park, and Isle Royale (Vucetich et al. 2011) concluded that predator and prey ratio accounts for only 56% of observed variance of prey population growth, at best. Stable prey populations may exist at a wide range of predator densities, and predation rate cannot be used reliably to determine whether predation is causing prey population declines. Climate variables, human exploitation levels, and the suite of species present in an area will all influence predator-prey dynamics. The provincial draft wolf management plan also notes that there is no scientific consensus on the role of wolves in prey dynamics, and that wolf abundance and distribution are regulated by ungulate supply, human-caused mortality, territorial behaviour, and disease. Wolves are assessed as part of the large carnivore species group in the effects assessment.

Current provincial management of grizzly bears is within Grizzly Bear Population Units (GBPU) drawn along natural and ecological boundaries. Grizzly Bear Population Units within the Peace River valley include the Rocky, with a population estimated at 538 bears, and the Moberly, with an estimated 71 bears. These units include portions of the Peace River between Hudson's Hope and Bear Flat. The remainder of the Peace River valley is not included in a GBPU, but is classified as an area where grizzly bears are extirpated.

The frequency of grizzly bear dispersal through the Peace River valley has not been well documented, but is infrequent based on the province's population and habitat data. Data from DNA studies do not indicate fragmentation within northern grizzly bear populations (Proctor et al. 2012). Patterns of recorded mortalities suggest that there are currently no physical barriers to grizzly bear movements in northeastern B.C., and that movement is instead limited by conflicts with people and associated grizzly bear mortalities (B.C. Ministry of Environment, Large Carnivore Specialist, 2012, pers. comm.). Habitat suitability around the eastern portion of the Peace River valley is relatively low and

therefore less likely to attract or support dispersing bears (A. Hamilton, B.C. Ministry of Environment, pers. comm. September 2012).

Grizzly bear mortality risk is often assessed using an analysis of road density (Mattson 1993; Mace et al. 1996; Wakkinen and Kasworm 1997). A road density analysis was completed to evaluate changes in the LAA in road density due to the Project. Permanent roads are generally placed in areas where road density already exceeds a 1.2 km/km^2 threshold, and thus these areas are unlikely to be used by grizzly bears. The large unroaded areas south of the Peace River will remain virtually the same once temporary construction roads are removed. Grizzly bear are assessed as part of the large carnivore species group in the effects assessment.

For a more detailed discussion for large carnivores, see Part 7 of Volume 2 Appendix R Terrestrial Vegetation and Wildlife Report.

14.3 Effects Assessment

Section 12.2.4 of the EIS guidelines states the assessment of potential adverse effects on the VC will take:

> "into account the potential for the Project to result in changes to the following key aspects:
>
> - Permanent and temporary habitat alteration and fragmentation;
> - Disturbance and/or displacement; and
> - Potential for direct and indirect mortality to individuals."

The analysis of the effects of habitat alteration and fragmentation is a GIS-based analysis that provides a quantitative assessment measuring change within the LAA by overlaying the known areas of disturbance with ecosystem mapping, species habitat modelling, and known spatial locations of specific wildlife features, including nest sites, dens, hibernacula, leks, and lodges.

For species where habitat models are not effective – swallows, waterfowl, shorebirds, and Olive-sided Flycatcher – at defining the spatial extent of habitat use, a qualitative assessment in the potential change is considered. Resource Selection Function modelling and tree density modelling were used to analyze the effects of habitat alteration and fragmentation on ungulates and fisher, respectively.

Parts 2 through 7 in Volume 2 Appendix R Terrestrial Vegetation and Wildlife Report provide greater detail of modelling methodologies.

Species for which habitat modelling was completed are provided in Table 14.5.

Table 14.5 Species for Which Habitat Modelling Was Completed

Key Species group	Indicator Species	Aspect Modelled
Butterflies and dragonflies	Dragonflies	Breeding
	Aphrodite fritillary	Breeding
	Arctic blue	Breeding
	Arctic skipper	Breeding
	Assiniboine skipper	Breeding
	Common ringlet	Breeding
	Common woodnymph	Breeding
	Great spangled fritillary	Breeding
	Old world swallowtail	Breeding
	Tawny crescent	Breeding
	Uhler's arctic	Breeding
Amphibians and Reptiles	Western Toad	Reproducing-eggs
	Garter snake	Winter hibernation
Migratory Birds	Bay-breasted Warbler	Reproducing-eggs
	Black-throated Green Warbler	Reproducing-eggs
	Canada Warbler	Reproducing-eggs
	Cape May Warbler	Reproducing-eggs
	Connecticut Warbler	Reproducing-eggs
	Rusty Blackbird	Reproducing-eggs
	American Bittern	Reproducing-eggs
	LeConte's Sparrow	Reproducing-eggs
	Nelson's Sparrow	Reproducing-eggs
	Yellow Rail	Reproducing-eggs
	American Three-toed Woodpecker	Reproducing-eggs
	Pileated Woodpecker	Reproducing-eggs
	Yellow-bellied Sapsucker	Reproducing-eggs
	Common Nighthawk	Reproducing-eggs
Non-migratory Game Birds	Ruffed Grouse	Living all seasons
	Sharp-tailed Grouse	Living-growing season and Living-winter
Raptors	Boreal Owl	Reproducing-eggs
	Broad-winged Hawk	Reproducing-eggs
	Great Gray Owl	Reproducing-eggs
	Great Horned Owl	Reproducing-eggs
	Northern Goshawk	Reproducing-eggs
	Northern Harrier	Reproducing-eggs
	Northern Saw-whet Owl	Reproducing-eggs
	Short-eared Owl	Reproducing-eggs
Mammals	Bats	Feeding-growing season and Reproducing-birthing habitat

Construction noise and close proximity of people and machinery to suitable habitats can change animal behaviours. The assessment of potential effects on disturbance and displacement of wildlife is both a qualitative assessment of the timing and extent of disturbances in close proximity to suitable habitats.

The number of individuals hunted, poached, hit by vehicles, or lost due to construction and filling of the reservoir is difficult to quantify. A qualitative assessment of the likelihood of mortality based on the timing and frequency of activities and the proximity of roads and other Project components to suitable habitats is included.

14.3.1 Effects Assessment – Habitat Alteration and Fragmentation During Construction and Operations

Habitat alteration is defined as the permanent removal or loss of habitat or a reduction in habitat suitability for a species. Alteration of habitat can also lead to an increase in predation, decrease in security cover, and removal of seasonal forage, roost, nest, birthing, and den sites.

Habitat alteration does not just include direct habitat removal, but can also be a reduction of habitat suitability due to changes in hydrology, increased siltation, and other deleterious substances, and the introduction of invasive species. Changes in hydrology can reduce wetland size or create new areas of ponded water, depending on whether water inputs are decreased or increased. Sedimentation (introduction of sediments) can result in infilling of portions of wetlands, thereby altering water depth and smothering aquatic vegetation.

The proximity of construction sites along the edges of wet areas can increase water temperature in streams, change flows, and increase silt levels. The release of deleterious substances (including concrete, fuel, oil, and other hydrocarbons) can also be detrimental to terrestrial and aquatic environments. These substances, such as petroleum-based organic compounds, sediments, and de-icing agents can often run off paved roads during construction, maintenance and use (Buckler and Granato 1999). Also, as cited in Kociolek et al. 2011: Walker & Everett 1987, and Kalisz & Powell 2003.

The introduction of invasive species is considered habitat alteration. Physical barriers that prevent dispersal define the natural range and distribution of a species. Invasive species have circumvented these physical barriers and have been able to establish in areas where they were not previously known. Continued changes in land use, together with the spread of the human population, have made it possible for invasive species to increase their range, sometimes to the extent that they crowd out native species. The introduction and potential proliferation of the more aggressive invasive species ultimately alters the habitat, often leading to decreases in habitat suitability for native wildlife. Fragmentation of natural areas, especially by roads, provides more opportunities for the dispersal and establishment of non-native species, which in turn continues to alter and fragment natural areas.

Fragmentation involves the ‘separation’ of habitat patches into one or more pieces – a process that requires some portion of the original habitat patch or rare plant occurrence to be lost or transformed into less favourable or inhospitable habitat. Habitat fragmentation reduces the size and continuity of larger habitats, where the suitable habitats that remain may be too small to be effective at providing for various life stages

of a species. These smaller areas are also more susceptible to habitat alteration with continual influences from the activities that led to the fragmentation in the first place.

Specific to the Project, roads are considered to be a leading cause of fragmentation, although other Project components may also isolate smaller patches of suitable habitat. Edge habitat created by roads or other means can lead to a change in vegetation communities, which in turn can lead to a change in the wildlife community. The transmission line will fragment older forests, but could provide for greater amounts of suitable shrub and herb habitat for some species, dependent on operations. Specific to the transmission line, operations activities include mechanical and chemical (herbicide) vegetation maintenance that could cause short-term changes in vegetation and abundance, and potentially long-term changes in vegetation diversity and composition. These changes will benefit some species and be detrimental to others.

Changes due to habitat alteration and fragmentation can affect one or more life stages within or across species. Habitat alteration and loss through clearing of vegetation during site preparation will be the primary issue during the early construction stages. As construction proceeds, water diversions associated with dam construction have the potential to change flow regimes on the Peace River (see Section 11.4 Surface Water Regime in Volume 2 Section 11 Environmental Background for more details), which may affect wildlife and wildlife habitat along the river margins. In the final stages of construction, reservoir filling would constitute the majority of permanent loss of habitat.

Project components and activities during construction and operation have the potential to alter and fragment habitats used by wildlife and were summarized in Table 14.1. These include:

- **Dam, Generating Station and Spillways:** site clearing and preparation, temporary and permanent access roads, relocating surplus excess, sand and gravel source pits, existing infrastructure relocation, Stage 1 and Stage 2 channelization, and diversion works
- **Reservoir:** vegetation removal, flooding, Hudson's Hope shoreline protection, debris management, and bank erosion
- **Transmission Line:** vegetation removal, access construction and vegetation maintenance during operations
- **Highway 29 Realignment:** vegetation removal, temporary and permanent road construction, relocating and removing infrastructure and surplus materials, bridge construction, and shoreline protection
- **Construction Access Roads:** Site preparation, earthworks, drainage, and railway construction
- **Quarried and Excavated Materials:** Site preparation, earthworks, operations

Species with smaller home ranges or that have specific habitat requirements tied to the Peace River valley – especially riparian habitat – would be affected the most.

Suitable habitat, defined as moderate- and high-value habitat, has been selected for key indicators based on needs for sensitive life history requirements. Suitable habitat for most key indicators has been selected for reproduction needs. Winter habitats have also been selected for garter snakes, bats (hibernacula), and Sharp-tailed Grouse. Winter habitat for ungulates is considered the most important habitat for ungulate survival,

especially during severe winters, and was chosen for representing suitable habitats for the moose, elk, and mule-deer. The amount of designated Ungulate Winter Range that would be lost as a result of the Project is also included.

14.3.1.1 Butterflies and Dragonflies

Approximately 4,270 ha of potential dragonfly breeding habitat is available within the LAA, based on ecosystem mapping (Table 14.6). The total amount of potential breeding habitat loss during construction and operations is 796 ha, half of which is riparian wetlands (WH) associated with river backchannels. This represents 19% of the available habitat within the LAA. For clarification, the loss due to the reservoir clearing and filling (construction) is based on the full supply level; for operation, it is the additional loss between the full supply level and the erosion impact line.

The total amount lost is considered to be an overestimation, as quarry sites are expected to be smaller than the larger Project activity zone presented in this report and the loss of wetlands along the transmission line right-of-way is not anticipated; although the amount of habitat affected during operations is dependent on the activities planned. This is because wetlands and other non-forested areas would not be cleared unless road construction or tower placement were required. The total of 796 ha is also a duplication of some areas where clearing activities occur both during construction and operations.

The Highway 29 realignment does not overlap any potential dragonfly breeding habitats.

Table 14.6 Potential Habitat Loss – Breeding: Dragonflies

Forested and Non-Forested Ecosystems with Breeding Potential	Available Habitat in LAA (ha)	Phase	Loss of Suitable Habitat by Project Component (ha)						
			Dam Site	Reservoir	Transmission Line	Roads	Quarries	Total (ha)	Percent (%) Lost
Lake	194.4	Construction	0.0	0.0	0.3	0.1	0.0	0.4	0.8
		Operations	0.0	0.0	1.1	0.0	0.0	1.1	
Shallow Open Water	77.0	Construction	1.6	13.6	0.9	0.3	0.0	16.5	22.9
		Operations	0.0	0.0	1.1	0.0	0.0	1.1	
Pond	33.5	Construction	0.0	4.0	0.7	0.1	0.1	4.9	21.2
		Operations	0.0	0.4	1.8	0.0	0.0	2.2	
Sedge Wetland (SE 00)	1,168.9	Construction	39.9	47.0	34.7	19.0	1.1	141.8	16.8
		Operations	0.0	0.5	54.4	0.0	0.0	54.9	
Tamarack Sedge (TS 10)	1,404.5	Construction	12.9	13.1	32.1	9.1	0.4	67.5	8.1
		Operations	0.0	0.0	46.6	0.0	0.0	46.6	
Willow-Horsetail-Sedge riparian wetland (WH 00)	1,009.5	Construction	1.1	390.5	0.5	0.0	0.0	392.1	38.9
		Operations	0.0	0.8	0.3	0.0	0.0	1.1	
Willow Sedge Wetland (WS 00)	363.4	Construction	3.1	27.7	14.1	5.0	0.0	50.0	18.0
		Operations	0.0	0.0	15.5	0.0	0.0	15.5	
Narrow-leaved cotton-grass – Shore sedge (SBSwk2 Wf13)	8.5	Construction	0.0	0.0	0.0	0.4	0.3	0.7	8.2
		Operations	0.0	0.0	0.0	0.0	0.0	0.0	
Total			58.6	497.6	204.1	34.0	1.9	796.4	—

The habitat loss to butterflies differs based on a species' requirements. Of the 10 species for which habitat suitability modelling was produced, the great spangled fritillary loses the most amount of habitat (3,664 ha combined over both phases), whereas the Arctic skipper loses the greatest percentage (20% combined over both phases) from what is available within the LAA (Table 14.7). These numbers are based on potential loss of suitable habitats mapped within the Boreal White and Black Spruce moist, warm (BWBSmw1) biogeoclimatic subzone only. Similar to dragonflies, the amount of loss is considered an overestimate for the quarries and the transmission line.

Table 14.7 Potential Habitat Loss: Butterflies

Common Name	Total Suitable Habitat in LAA (ha)	Project Phase	Loss of Suitable Habitat by Project Component (ha)							
			Dam Site	Reservoir	Transmission Line	Highway 29	Roads	Quarries	Total (ha)	Percent (%)[b]
Aphrodite fritillary	**26,643.9**	Construction	1,136.7	1,027.1	325.9	168.7	155.2	92.7	**2,906.4**	**14.1**
		Operations	0.0	446.7	405.8	0.0	0.0	0.0	**852.5**	
Arctic blue	**3,859.8**	Construction	58.5	124.0	12.0	34.1	5.1	0.0	**233.8**	**9.8**
		Operations	0.0	133.9	10.5	0.0	0.0	0.0	**144.5**	
Arctic skipper	**7,142.3**	Construction	542.0	467.4	92.2	77.7	30.2	14.5	**1,224.0**	**19.7**
		Operations	0.0	86.8	95.0	0.0	0.0	0.0	**181.8**	
Assiniboine skipper	**6,487.4**	Construction	144.0	561.7	70.8	31.4	42.0	1.4	**851.4**	**16.5**
		Operations	0.0	131.6	89.1	0.0	0.0	0.0	**220.7**	
Common ringlet	**4,945.9**	Construction	81.1	190.0	12.0	43.9	5.4	0.0	**332.5**	**10.5**
		Operations	0.0	176.8	10.5	0.0	0.0	0.0	**187.4**	
Common woodnymph	**6,483.2**	Construction	144.0	581.5	70.9	31.4	42.0	1.4	**871.3**	**16.9**
		Operations	0.0	133.6	89.1	0.0	0.0	0.0	**222.7**	
Great spangled fritillary	**20,693.5**	Construction	990.6	1,773.7	164.8	113.2	89.2	52.9	**3,184.5**	**17.7**
		Operations	0.0	301.5	178.2	0.0	0.0	0.0	**479.7**	
Old world swallowtail	**3,473.7**	Construction	65.7	142.3	12.0	31.4	4.3	0.0	**255.8**	**12.1**
		Operations	0.0	153.8	10.5	0.0	0.0	0.0	**164.4**	
Tawny crescent	**25,962.5**	Construction	1,076.6	974.9	278.9	167.1	129.4	91.3	**2,718.3**	**13.7**
		Operations	0.0	476.9	349.5	0.0	0.0	0.0	**826.4**	
Uhler's arctic	**3,893.3**	Construction	58.5	124.0	12.0	34.1	5.1	0.0	**233.8**	**9.7**
		Operations	0.0	133.9	10.5	0.0	0.0	0.0	**144.5**	
Total			**4,297.7**	**8,142.1**	**2300.2**	**733.0**	**507.9**	**254.2**	**16,236.4**	**—**

Changes in hydraulic patterns and water quality and quantity as a result of the Project can alter invertebrate habitat. Suitable habitats can shift from an herbaceous wetland community to a shrub community as a result of a reduction in water. Conversely, increases in water may also contribute to habitat loss as the inundation of smaller wetlands, leading to greater areas of ponded water, may change the vegetation composition, distribution, and abundance to something less favourable (Cannings et al. 2011).

The proximity of Project roads and other construction sites along the edges of wet areas or immediately upstream can increase water temperature in streams, change flows, and increase silt levels which negatively affects larvae (Cannings et al. 2011). Sediments can fill in portions of wetlands, altering water depth, and smothering aquatic vegetation. Inorganic sedimentation can cause a direct effect on aquatic life-stages, as particles of sediment can accumulate on respiratory structures and body surfaces (Lemly 1982). The

release of deleterious substances – including concrete, fuel, oil, and other hydrocarbons – can also be detrimental to terrestrial and aquatic environments.

14.3.1.2 Amphibians and Reptiles

Amphibians and reptiles are vulnerable to a variety of habitat alteration and fragmentation, due to reduced ability to move and migrate freely, and there is an increased vulnerability to mortality when moving across roads or through inhospitable environments. The direct loss of habitat is the primary effect of the Project on amphibians and reptiles. This includes the physical removal of vegetation, seasonal flooding due to confinement of the river channel during construction, temporary construction sites including roads, reservoir filling, and continued erosion during reservoir operations.

Approximately 38% of the 13,864 ha of suitable western toad habitat available within the LAA will be lost due to construction and operations (Table 14.8). The majority of this habitat loss will be the result of filling of the reservoir. Similar to above, the amount of loss is considered an overestimate for the quarries and the transmission line. The Highway 29 realignment does not overlap any potential amphibian breeding habitats.

For garter snakes, 15% of suitable hibernation habitat will be lost due to the Project, the majority of which is a result of the filling of the reservoir (Table 14.8).

Table 14.8 Habitat Loss: Amphibians and Reptiles

Species	Total Suitable Habitat in LAA (ha)	Project Phase	Loss of Suitable Habitat by Project Component (ha)						
			Dam Site	Reservoir	Transmission Line	Hwy Realign	Roads	Quarries	TOTAL
Western toad	**13,864**	Construction	208	4,763	102	0	37	2	**5,112**
		Operations		34	137	0	0	0	**171**
Garter snake	**4,084**	Construction	90	228	14	39	4	0	**375**
		Operations	0	222	13	0	0	0	**235**

Project construction activities may alter water quality and quantity, in turn affecting amphibian breeding habitat and some snake foraging sites. Sediments can fill in portions of wetlands, altering water depth and smothering aquatic vegetation, rendering them unsuitable for breeding. Increased turbidity affects amphibian eggs, larvae, and adults by interfering with respiration, forage, and shelter (Matsuda et al. 2006). The release of deleterious substances – including concrete, fuel, oil and other hydrocarbons – can also be detrimental to terrestrial and aquatic environments, and the permeable skin of amphibians makes them particularly susceptible to harmful chemicals in the environment (Blaustein et al. 1995; Stuart et al. 2004). Impacts to western toad can occur throughout all life-history phases from pesticide applications (Zevit and Wind 2010).

Where roads cause a loss of connectivity between breeding areas and upland habitat, the result can negatively impact populations (Zevit and Wind 2010). In altered landscapes, a spatial separation often occurs between terrestrial habitat and breeding sites (Becker et al. 2007). In species with an aquatic larvae life stage, adults leave terrestrial environments to reach bodies of water for reproduction. In fragmented landscapes, adults may have to travel through areas with multiple hazards such as

increased predation risk, exposure to chemicals and pollutants, and road traffic. For snakes, a reduction in the ability of males to locate females due to road-induced fragmentation can lead to females not reproducing. This could be the result of obstructions to the effectiveness of trail following by males, resulting in longer distances travelled and longer time to locate a potential mate, which may increase exposure and mortality risk (Shine et al. 2004).

14.3.1.3 Migratory birds

As indicated in Table 14.4, migratory birds include songbirds, waterfowl, shorebirds, marsh birds (specifically Yellow Rail, American Bittern, Nelson's Sparrow, and Le Conte's Sparrow), woodpeckers, swallows, and Common Nighthawk. Over 150 species occur within the LAA, so the determination of effects for each species is not possible. Instead, the assessment of effects focuses on migratory bird species that are provincially Red- and Blue-listed or species listed federally (SARA) (Table 14.4).

Based on habitat suitability mapping, there is a total of 202,822 ha of suitable habitat within the LAA combined for all of the selected migratory bird species (Table14.9). For Black-throated Green Warbler, Canada Warbler, Rusty Blackbird and Common Nighthawk, the life requisites have been rated for all subzone variants within the LAA. All other migratory species with habitat suitability modelling have been rated only within the BWBSmw.

The loss of valley bottom forest that overlaps the proposed reservoir will have an effect on a number of songbird species. The valley has the greater songbird diversity compared to upland habitats and contains some of the rare forested ecosystems that are unique to riparian floodplains (Volume 2 Section 13 Vegetation and Ecological Communities). Some of these communities (e.g., Spruce-Currant-Horsetail – 07/SH and Black cottonwood-Red-osier dogwood – 09/Fm02) are also suitable habitats for rare warblers.

The habitat loss to rare songbirds differs based on species requirements. Of the rare songbird for which habitat suitability modelling was completed, the Canada Warbler, Cape May Warbler, and Bay-breasted Warbler lose the highest percentage of habitat – 21.9%, 20.9% and 20.1% respectively – combined over both Project phases. Nearly 61% of the point count stations with Black-throated Green Warbler detections, 47% of the point count stations with Canada Warbler detections, and 51% of the point count stations with Connecticut Warbler detections are within or immediately adjacent to the Project activity zone.

Table 14.9 Habitat Loss: Migratory Birds

Group	Species	Total Suitable Habitat in LAA (ha)	Project Phase	Loss of Suitable Habitat by Project Component (ha)							
				Dam Site	Reservoir	Transmission Line	Hwy Realign	Roads	Quarries	Total	Total (%)
Songbirds	Bay-breasted Warbler	15,639.8	Construction	101.7	2,243.1	102.3	62.9	36.7	88.2	2,634.9	16.8
			Operations	0.0	523.0	0.0	0.0	0.0	0.0	523.0	3.3
	Black-throated Green Warbler	34,775.9	Construction	459.3	2,789.3	261.1	74.7	120.6	169.9	3,874.9	11.1
			Operations	0.0	760.7	0.0	0.0	0.0	0.0	760.7	2.2
	Canada Warbler	12,032.9	Construction	632.3	1,249.8	72.5	48.0	41.0	3.5	2,047.1	17.0
			Operations	0.0	590.8	0.0	0.0	0.0	0.0	590.8	4.9
	Cape May Warbler	9,748.6	Construction	74.9	1,584.8	47.6	27.3	17.4	67.0	1,819.0	18.7
			Operations	0.0	212.4	0.0	0.0	0.0	0.0	212.4	2.2
	Connecticut Warbler	27,035.1	Construction	571.1	1,054.6	326.5	68.6	163.5	132.9	2,317.2	8.6
			Operations	0.0	484.4	0.0	0.0	0.0	0.0	484.4	1.8
	Rusty Blackbird	1,698.4	Construction	3.0	12.3	54.8	0.0	12.2	0.0	82.3	4.8
			Operations	0.0	0.0	50.2	0.0	0.0	0.0	50.2	3.0
Marsh birds	Le Conte's Sparrow	4,533.6	Construction	88.2	708.9	94.1	0.0	33.6	1.9	926.7	20.4
			Operations	0.0	1.6	128.6	0.0	0.0	0.0	130.2	2.9
	Nelson's Sparrow	4,533.6	Construction	88.2	708.9	94.1	0.0	33.6	1.9	926.7	20.4
			Operations	0.0	1.6	128.6	0.0	0.0	0.0	130.2	2.9
	Yellow Rail	2,043.2	Construction	42.0	295.7	50.5	0.0	23.2	1.4	412.8	20.2
			Operations	0.0	0.2	73.5	0.0	0.0	0.0	73.7	3.6
Woodpeckers	American Three-toed Woodpecker	21,581.3	Construction	69.3	2,009.7	215.7	38.4	77.8	128.1	2,539.0	11.8
			Operations	0.0	479.2	0.0	0.0	0.0	0.0	479.2	2.2
	Pileated Woodpecker	14,463.3	Construction	39.7	1,497.8	134.0	2.0	41.7	92.0	1,807.2	12.5
			Operations	0.0	242.1	0.0	0.0	0.0	0.0	242.1	1.7
	Yellow-bellied Sapsucker	40,274.1	Construction	1,017.6	3,180.1	315.9	136.3	144.4	181.5	4,975.8	12.4
			Operations	0.0	812.4	0.0	0.0	0.0	0.0	812.4	2.0
Common Nighthawk		14,462.3	Construction	178.1	1,630.6	83.7	201.9	28.1	194.1	2,316.5	16.0
			Operations	0.0	135.3	120.0	0.0	0.0	0.0	255.3	1.8

While habitat suitability mapping was not completed for waterfowl and shorebird species the change in general habitat classes (river, backchannel, lake and wetland) are used as a proxy for habitat use. The reservoir will convert approximately 83 km of river and associated backchannel habitat into a reservoir. The waterfowl species assemblage are expected to change, and overall productivity will be dependent on forage potential and the availability of both security cover and nesting substrates (e.g., dense wetland vegetation or older forests with suitable nest cavities).

With the filling of the reservoir, ice formation will now occur on an annual basis, where it has not readily occurred in the past (Volume 2 Appendix H Reservoir Water Temperature and Ice Regime Technical Data Report). Based on the 2013 spring data and ice modeling, ice break-up will occur most often in April at a time when many waterfowl species start arriving to the area. The greatest potential for effects is to early migrating birds, in particular the three species present in March in the greatest numbers (Canada Goose, Common Goldeneye and Common Merganser). Common Merganser tend to congregate immediately downstream of the Peace Canyon dam and can be expected to congregate immediately downstream of the Site C dam as well. These areas typically remain ice free in the winter (Volume 2 Appendix H Reservoir Water Temperature and Ice Regime Tech Data Report), although the overall extent of ice coverage on the proposed reservoir is dependent on temperature. ~~This will remove staging habitat for some waterfowl species that have used the ice-free portions of the river in early spring. The extent of the ice sheet and timing of thaw will be dependent on winter severity and early spring temperatures, although modelling typically shows most of the ice gone by late April.~~

Woodpeckers will lose approximately 12% of suitable habitat within the LAA during construction (for all species modelled). Common Nighthawk will lose 16% of the available habitat within the LAA during construction, although suitable habitat will be temporarily created with vegetation clearing within the proposed reservoir area. If these new cleared areas are used for nesting, then additional effects of displacement and possible mortality could occur with seasonal flooding (see below).

Bank-nesting species such as swallows will also be affected by reservoir filling and bank erosion, and additional nest sites would be lost during dam construction and bridge removal for Highway 29 realignment. Violet-green Swallow and Cliff Swallow nest sites near Hudson's Hope should mostly persist, as the extent of flooding is minimal in this area. Nesting sites associated with bridges and slopes will be recolonized upon completion of construction and as slopes re-stabilize during operations. Furthermore, the dam and associated power generating facilities should also offer nest sites for a number of species, including Barn Swallow, providing there is minimal human disturbance.

The percentage loss of marshbird habitat is similar for Le Conte's Sparrow, Nelson's Sparrow, and Yellow Rail. The loss of Watson's Slough will affect all three species, although the species were reported in other areas south of the Peace River. Loss from the construction of the transmission line is not anticipated, but this is dependent on tower placement, road alignments, and activities planned during operations.

Additional potential issues associated with the Project that alter habitats, possibly reducing habitat suitability for some species include:

- Changes in hydraulic patterns and surface water regimes that alter habitat by reducing river flow, eliminating seasonal flow variability, sediment movement, and channel stability (McAllister et al. 2001)
- Increased siltation that infill portions of wetlands, thereby altering water depth and smothering vegetation
- The release of deleterious substances (Buckler and Granato 1999); also, as cited in Kociolek et al. 2011: Fay & Kociolek 2009
- Dust; as cited in Kociolek et al. 2011: Walker & Everett 1987, and Kalisz & Powell 2003.

- The introduction and proliferation of invasive species

14.3.1.4 Non-Migratory Game Birds

Based on habitat suitability mapping, there is 52,659 ha of suitable habitat for Ruffed Grouse, 22,920 ha of suitable habitat for Sharp-tailed Grouse in the growing season, and 9,697 ha of suitable habitat for Sharp-tailed Grouse in the winter available within the LAA (Table 14.10).

Clearing of vegetation and filling of the reservoir will result in loss of foraging habitat, security habitat, and possible nesting locations. The potential loss of 15% of the available Ruffed Grouse suitable habitat is considered an overestimation, as quarry sites are to be smaller than the area used in this assessment of potential effects, and the transmission line right-of-way may increase the amount of suitable habitat, with the creation and maintenance of younger forest types. The projected loss of 18% of both suitable habitat types for Sharp-tailed Grouse is also considered an overestimation for similar reasons. The Highway 29 realignment has the potential to affect a known lek site but any interaction is dependent on the selection of the final alignment. The known lek site at Area E is located immediately adjacent to the Project component boundary, but not within the boundary.

Table 14.10 Potential Habitat Loss: Ruffed Grouse and Sharp-Tailed Grouse

Common Name	Total Suitable Habitat in LAA (ha)	Project Phase	Loss of Suitable Habitat by Project Component (ha)						
			Dam Site	Reservoir	TL	Hwy 29	Roads	Quarries	Total
Ruffed Grouse	52,659	Construction	1,307.5	3,919.5	546.5	193.9	243.9	288.0	6,499.3
		Operations	0.0	907.8	651.0	0.0	0.0	0.0	1,558.8
Sharp-tailed Grouse Growing Season	22,920	Construction	344.8	2140.5	211.9	314.5	77.7	209.1	3,298.5
		Operations	0.0	353.6	405.8	0.0	0.0	0.0	759.4
Sharp-tailed Grouse Winter Season	9,697	Construction	122.5	871.5	160.1	51.0	62.1	47.2	1,314.5
		Operations	0.0	159.7	245.7	0.0	0.0	0.0	405.4
Totals			1,774.8	8,352.6	2221	559.4	383.7	544.3	13,835.9

14.3.1.5 Raptors

Based on habitat suitability mapping, there is a combined 152,399 ha of suitable habitat within the LAA for the selected raptor species (Table 14.11). The percentage loss of habitat from the Project activity zone for raptor species varies between 11% (Broad-winged Hawk) and 20% (Northern Saw-whet Owl) of what is available within the LAA. Habitat losses will occur predominately during the initial clearing activities, but additional losses will continue into operations with bank erosion and ongoing vegetation maintenance along the transmission line. Northern Harrier and Short-eared Owl should

benefit from the early seral vegetation maintained along the transmission line, as they are more tolerant of this vegetation type.

Table 14.11 Potential Habitat Loss: Raptors

Species	Total Suitable Habitat in LAA (ha)	Project Phase	Loss of Suitable Habitat by Project Component (ha)						
			Dam Site	Reservoir	Transmission line	Highway Realignment	Roads	Quarries	TOTAL
Boreal Owl	16,010.0	Construction	61.1	1,594.6	160.0	15.5	54.1	89.5	1,974.6
		Operation	0.0	247.8	145.8	0.0	0.0	0.0	393.6
Broad-winged Hawk	25,927.3	Construction	509.8	1,041.7	263.6	68.6	124.9	132.7	2,141.4
		Operation	0.0	496.9	236.7	0.0	0.0	0.0	733.6
Great Gray Owl	16,206.8	Construction	61.1	1,592.9	163.1	15.5	54.3	108.1	1,995.1
		Operation	0.0	247.8	148.9	0.0	0.0	0.0	396.7
Great Horned Owl	15,256.8	Construction	61.1	1,611.9	148.0	2.0	46.3	108.1	1,977.4
		Operation	0.0	250.2	134.4	N/A	N/A	N/A	384.6
Northern Goshawk	38,820.0	Construction	568.6	2,852.1	308.5	77.7	159.0	257.3	4,223.1
		Operation	0.0	839.1	277.9	0.0	0.0	0.0	1,117.0
Northern Harrier	13,105.0	Construction	183.5	878.0	91.7	192.8	32.7	166.6	1,545.3
		Operation	0.0	125	131.3	0.0	0.0	0.0	256.3
Northern Saw-whet Owl	12,917.4	Construction	55.5	1,935.4	141.7	4.3	39.9	65.3	2,242.1
		Operation	0.0	174.8	129.6	0.0	0.0	0.0	304.4
Short-eared Owl	14,155.9	Construction	167.7	1,031.8	103.7	196.7	38.1	167.1	1,705.0
		Operation	0.0	138.7	220.3	0.0	0.0	0.0	359.0

Of the 59 Bald Eagle nests observed in 2011, 32 will be lost with the construction of the Project. The only other known nests of targeted species that will be removed are Northern Goshawk nests. Of the eight known goshawk nests, two are within the proposed reservoir and will be lost.

Habitat fragmentation can further lead to a decrease in the availability of suitable habitat, especially for species that prefer to nest in the interior of older forest stands, away from forest edges. Remnant patches of older forest may not meet thermal requirements or provide stand structures that assist in predator avoidance or sub-canopy flight – notably for Broad-winged Hawk and Northern Goshawk. In addition, Hinam and St. Clair (2008) suggested that, although low levels of fragmentation and habitat loss may benefit Northern Saw-whet Owls through possible increases in prey abundance, a reduction in foraging efficiency and reproductive success coupled with increased stress appears to be correlated with high levels of fragmentation and habitat loss. The same thing can be said for species that prefer open sites. Fragmentation of grassland and field habitats suitable for Short-eared Owl can lead to increased nest predation and reproductive failure (Johnson and Temple 1986).

14.3.1.6 Mammals

14.3.1.6.1 Bats

Vegetation clearing, facilities construction, and reservoir filling will result in the loss of roost sites and foraging habitat. The loss and fragmentation of roosting and foraging habitat is considered a threat to bats (Russell et al. 2008). While some habitat disturbance or tree removal on a small scale may increase the area of foraging habitats and travel corridors for bats, forests are necessary for roosting and foraging habitat for forest-feeding species (Grindal and Brigham 1998). Clearing of forest cover will directly eliminate roost trees, and may cause additional losses of roost trees adjacent to the cleared area indirectly through “wind throw”.

Project construction could directly affect 23% of the available suitable foraging habitat for bats within the LAA and 11% of the total reproducing habitat within the LAA (Table 14.12). It is important to note that not all of the foraging habitat within each Project component will become unusable to bats after Project construction. Foraging opportunities will still be available over the water of the reservoir and over the open habitat of the transmission line.

Operations are expected to affect less than 3% each of the currently suitable foraging and reproducing habitat within the LAA (Table 14.12). Again, the estimate of foraging habitat loss is considered an overestimate within the transmission line right-of-way.

Table 14.12 Potential Habitat Loss: Bats

Total Suitable Habitat in LAA (ha)	Project Phase	Loss of Suitable Habitat by Project Component (ha)						
		Dam Site	Reservoir	Transmission line	Highway Realignment	Roads	Quarries	TOTAL
Foraging Habitat (ha)								
31,450.7	Construction	246.3	6,356.5	297.5	2.1	115.2	110.6	7,128.2
	Operations	0.0	255.9	325.7	0.0	0.0	0.0	581.6
Reproducing Habitat (ha)								
33,758.8	Construction	647.8	2,454.4	303.1	71.1	136.2	215.2	3,827.8
	Operations	0.0	713.7	0.0	0.0	0.0	0.0	713.7

Effects of inundation on foraging habitats are less clear. Open water habitats do provide foraging opportunities for bats, especially during hatches of aquatic insects (Grindal et al. 1999). Rebelo and Rainho (2009) reported a clear decline in bat activity over foraging areas submerged during reservoir creation in Portugal, while islands that remained above water retained similar foraging activity levels. Bat foraging activity also increased in riparian habitats surrounding the reservoir.

Blasting and excavation through cliffs, rock outcrops, and cutbanks, and removal of bridges could potentially remove bat roosts and hibernacula. Bridge removal and reconstruction would occur at Halfway River, Farrell Creek, Lynx Creek, and Cache Creek. Field surveys of bats revealed that Halfway River, Farrell Creek, and Cache Creek bridges in particular are used by bats as night roosts. Results of the acoustic

sampling in 2012 suggest that the rock crevice habitat at Portage Mountain is used for hibernation. Extraction of rock from that site could remove any hibernacula present.

Clearing may result in changes in the community structure of the insects on which bats forage. Dodd et al. (2012) reported that abundance of moths decreased after forest disturbance in the Appalachians, while that of flies increased, and the abundance of beetles remained unchanged. Bat activity, as measured by numbers of echolocation detections, was also positively correlated with disturbance. Changes in vegetation structure from clearing may result in changes in the bat species assemblages that use these areas.

Temporary artificial lighting will be used to illuminate construction areas and permanent lighting will be installed at facilities during operation. While some bat species are attracted to the insects that congregate at street lamps, other species avoid lights (Rydell 2006). The use of artificial lights that deter bat species from using the illuminated space results in habitat loss.

14.3.1.6.2 Beaver

With the filling of the reservoir, over 60 beaver lodges will be lost along the Peace River and tributaries. Fluctuating water levels during construction have the potential to remove some of these prior to filling when construction of the dam is complete. The removal of vegetation in riparian areas during reservoir clearing has the potential to decrease food availability prior to inundation. Additional work around upland wetlands may alter habitat through the introduction of deleterious substances and changes in hydrology.

Construction of the dam will impede movements of animals along the river between the reservoir and the river downstream of the dam. During operations, the changes in flows – most pronounced in the first 16 km immediately downstream of the dam – may remove lodges and food caches. Within the reservoir bank, erosion is expected to reduce habitat quality for beavers. This will continue until slopes become more stable. The formation of ice on the reservoir and fluctuations in the level of the reservoir, although limited, may inhibit use.

14.3.1.6.3 Fisher

The loss of riparian valley bottom forest that overlaps the proposed reservoir will have an effect on fisher. The Project will remove 1,973 ha of potential reproductive denning habitat in the LAA. This equates to 14% of the suitable habitat available within the LAA (Table 14.13). Cavity tree surveys estimate that 2,950 potential reproductive den trees will be lost during habitat removal, representing about 15% of the suitable den trees available in the LAA. The majority of the potential dens trees that would be lost are within the reservoir (2,232) and dam site (374) areas. Three den trees used by one female (F03) in this study were located within the LAA along the Halfway River. One of these den trees is within the proposed reservoir and would be removed.

Table 14.13 Potential Habitat Loss: Fisher

Total Suitable Habitat in LAA (ha)	Project Phase	Loss of Suitable Habitat by Project Component (ha)						
		Dam Site	Reservoir	TL	Hwy Realignment	Roads	Quarries	Total
14,142.6	Construction	45.0	1,690.1	110.2	4.3	34.3	89.5	1,973.4
	Operation	0.0	199.1	0.0	0.0	0.0	0.0	199.1

Based on the fisher density calculated for the Project, 4.28 fishers would be expected to occur in the LAA, and 0.72 fishers would be affected by the habitat loss. The fisher density calculated during the Peace River fisher study is much lower than the reported density in the Williston and Kiskatinaw study areas, and several factors indicate that the fisher population on the south is far below the carrying capacity for that area. The factors are listed below:

- The north provides 29,162 ha of suitable habitat in the trap area (Year 2) and had an estimated density of 7.7 fishers/1,000 km^2, while the south provides 31,404 ha of suitable habitat and had an estimated density of 2.6 fishers/1,000 km^2.
- The fisher trap efficiency on the north (0.0111 captures per trap night) was double the trap efficiency on the south (0.0050 captures per trap night).
- The trap efficiency for marten on the south (incidentally taken during fisher trapping) was double that observed on the north (captures per trap night = 0.1155 north and 0.2476 south). The abundance of marten indicates that the area is not being overharvested. It is not known how marten abundance, distribution, or behaviour influences fisher populations, but their relative size suggests the potential to compete for resources, particularly prey (Lofroth et al. 2010). It is unlikely that marten numbers are reducing fisher presence; other unknown factors are probably limiting the fisher population on the south of the Peace River.
- Trapping records indicate that few fishers have been trapped on the south, with 40 fishers captured in 25 years. Interestingly, two fishers were trapped on the south – including one study animal – during the Year 2 baseline fisher telemetry study.

Habitat fragmentation will affect the ability of fishers to move between patches of suitable habitat. In particular, riparian forests are often used as travel corridors, and loss of riparian habitat along the Peace River is expected to affect the movement of resident animals. Study animals were observed travelling along the Peace River during movements within their home range and during dispersal (e.g., F02 moving along lower floodplain near Moberly confluence, M05's telemetry and hair-snag locations along the river corridor, F12 dispersal). Connectivity of forest cover is important, as fishers avoid habitats that do not have overhead cover (Weir 1990; Powell et al. 1997; Weir and Harestad 1997). Lofroth (2010) reported that the amount of contiguous canopy cover was the most consistent predictor of fisher occurrence. Fragmentation will also affect prey species composition, abundance, and availability, which could have energetic costs to fishers, ultimately affecting survival, reproduction, and recruitment (Weir and Corbould 2008).

Linear features such as highway (> 90 km/hour), roads, the transmission line right-of-way, and reservoirs may act as filters or barriers to fisher movement, preventing population expansion and gene flow (Naney et al. 2012). Field observations and DNA

analysis has confirmed that the Peace River is currently not a barrier to movement, and that fishers on the north and south sides of the river form one contiguous population. The filling of a reservoir has the potential to impede movement of individuals, but this is not anticipated to be a concern for the population.

14.3.1.6.4 Ungulates

The direct loss of habitat is the primary effect of the Project on ungulates. Loss of wintering habitat is considered to be most important, but the loss of other seasonal habitats (e.g., birthing) were also considered for each species. In northern populations, resources available to ungulates in winter are limited by snow accumulations, leaving access to generally poorer quality foods compared to what is available in other seasons. Habitat use and selection data demonstrated that radio-tagged moose, elk, and mule deer accessed a wider variety of habitats in spring, summer, and fall than they did in winter. Larger mortality events are consistently in winter, and government habitat management programs focus on maintaining ungulate winter ranges to reduce foraging stresses on ungulate populations. Changes to habitat in other seasons are unlikely to influence moose, elk, and mule deer survival, productivity, or population size.

Moose preferred valley bottom floodplains in winter, but were able to access most habitats within their range during all but the most severe winter periods. Elk favoured similar habitats, but were able to access a wider range of habitats than deer in most years. Mule deer were most numerous on steep south aspect slopes along the Peace River and its main tributaries in most winters. White-tailed deer rarely use wintering habitats that would be affected by the Project, so effects on that species are expected to be minimal.

Based on habitat mapping, hectares of suitable winter habitat and Ungulate Winter Range (UWR) were quantified within the LAA for moose, elk, mule deer, and white-tailed deer (Table 14.14). The amount potentially lost was quantified for each Project component during construction and operation. Loss associated with the transmission line is likely overestimated, as much of the younger, shrub-dominated habitat would remain during operations.

Table 14.14 Habitat Loss by Ungulate Species in the LAA

Species	Total Available (ha)	Project Phase	Loss of Suitable Habitat by Project Component (ha)						
			Dam Site	Reservoir	TL	Hwy Realign	Roads	Quarries	Total
Moose	75,603	Construction	1,505	8,770	761	298	338	430	**12,102**
		Operation	0	1,375	1,249	0	0	0	**2,624**
Elk	71,871	Construction	1,615	8,947	577	459	239	556	**12,395**
		Operation	0	1,409	983	0	0	0	**2,392**
Mule Deer	27,901	Construction	353	6,337	117	156	43	177	**7,182**
		Operation	0	714	139	0	0	0	**853**
White-tailed Deer	8,617	Construction	87	424	138	15	59	40	**763**
		Operation	0	219	289	0	0	0	**508**
UWR	2,578	Construction	0	365	0	0	0.1	0	**365**
		Operation	0	113	0	0	0	0	**113**

Less severe winters, which have been more common recently in the Peace Region, and access to agricultural crops have allowed elk and deer to reach high densities in parts of the LAA. Elk numbers have steadily increased, suggesting that they have not reached a habitat limited population. Deer numbers appear to have measurable fluctuations

between years and will likely continue to do so, regardless of the Project. Portions of four UWRs are present within the LAA (SPE-001, 003, 014, and 025) but only SPE-001 has habitat removed during construction and operation. Though a third of the SE-001 is being removed, this represents approximately 20% of the available UWR within the LAA.

Others have documented cases of islands being used for parturition (Edwards 1983; Timmermann & McNicol 1988; Poole et al. 2007). Islands in the Peace River valley and in the reservoir area in general were rarely used for birthing by collared moose, elk, mule deer, or white-tailed deer. Potential effects of the Project on reproduction of ungulates are expected to be low, since only a small proportion of habitats used for birthing will be influenced by the Project.

The construction of roads and the resulting traffic could have three main effects on ungulate populations: 1) a reduction in available suitable habitat and resource variety, 2) a decrease in movement across roadways, potentially causing habitat fragmentation and genetic isolation, and 3) vehicular collisions resulting in mortality (Gagnon et al. 2007). Ungulates, particularly elk and moose, are known to avoid areas in proximity to roads (Gagnon et al. 2007). Several well-used roads and highways traverse the LAA; existing roads do not seem to form barriers to movement, since every collared animal incorporated existing roadways within their annual range. Some suitable habitat will be affected with the construction of both temporary and permanent roads, but a restriction of movement is not expected to be measurable.

Effects on ungulate movement across the reservoir to suitable wintering habitats were also considered. Ice formation will now occur on an annual basis where it has not occurred for some time (Volume 2 Appendix H Reservoir Water Temperature and Ice Regime Technical Data Report). Movement to winter ranges occurs in the fall, prior to freezing most years. Ungulates rarely crossed the flowing river in winter and it is expected that avoidance of the unfrozen reservoir in winter would continue. When the reservoir freezes, it is expected to facilitate more winter movements. The reservoir would be relatively narrow, and it is expected that most individuals would continue to swim across during the spring, summer, and fall seasons, although debris levels within the reservoir and bank stability may hamper movement.

14.3.1.6.5 Large Carnivores

Habitat loss and fragmentation are primary factors limiting grizzly bear populations in B.C. (B.C. Ministry of Water, Land and Air Protection 2004a) and have caused a decline in grey wolf populations through North America (Boitani 2003, cited in Leonard et al. 2005). Resident grizzly use within much of the Project activity zone is considered to be scarce or nonexistent. Thus, habitat loss to the species was not considered.

Road densities exceed published thresholds for road density for wolf persistence (Mech et al. 1988; Thiel 1985), but larger patches with few roads do occur. The greater restriction to wolf movement and occurrence in some parts of the LAA is considered to be caused by mortality. Hunting, trapping, and predator control are affecting local populations.

14.3.2 Effects Assessment – Disturbance and Displacement During Construction and Operations

Disturbance and displacement refers to activities that cause individuals to alter their behaviour or to avoid habitats that are otherwise suitable.

Wildlife resources would be displaced as a result of the timing of flow releases and construction headpond flooding resulting from seasonal and daily fluctuations in water level – upstream of the dam during construction and downstream of the dam during operation – most notably, downstream to the Pine River confluence. During Stage 1 and Stage 2 of dam construction, the confinement of the flow past the dam site would cause the Peace River to flood upstream of the dam site. The extent of flooding would be dependent on the amount of water within the system, and is dependent on flow releases from the Peace Canyon Dam and natural inputs from tributaries. The spring freshet is expected to increase flooding at a time when many species are breeding.

A summary of expected disturbance and displacement effects by key indicator group is provided below.

14.3.2.1 Butterflies and Dragonflies

The effect of disturbance on butterflies and dragonflies is difficult to quantify; a species' persistence in an area is considered to be more strongly related to habitat quality, rather than proximity to activities. Displacement is expected when temporary changes force individuals to flee or relocate from suitable habitat.

As stated above, headpond flooding (during construction) and temporary flooding immediately downstream (during operations) may lead to displacement, depending on the season. This would be expected only for adult life stages, as immediate effects on egg or larval stages are linked more with mortality.

14.3.2.2 Amphibians and Reptiles

Disturbance to amphibians and reptiles due to noise or human presence is difficult to quantify; similar to butterflies and dragonflies, a species' persistence in an area is considered to be more strongly related to habitat quality, rather than proximity to activities. Displacement is expected when changes or noise force individuals to flee or relocate. This could result in increased energy expenditures, utilization of suboptimal habitats, and increased predation risk.

Similar to butterflies and dragonflies, headpond flooding (during construction) and temporary flooding immediately downstream (during operations) may lead to displacement, depending on the season. The spring freshet may lead to an increase in flooding upstream of the dam during construction, and may lead to displacement at a time when amphibians may be breeding.

The dam site and other Project components would require artificial lighting. There are few actual data on the effects of artificial lighting on free-living amphibians. Inferences from laboratory studies suggest artificial lighting may have effects on amphibian migration and metamorphosis, and light pollution may pose a serious threat to reptiles and amphibians in urban environments (Perry et al. 2008). Artificial light may interfere with movements to breeding areas or inhibit frog breeding choruses (Longcore and Rich 2004; Baker and Richardson 2006). Some frog species may be attracted to

artificially lit areas. It is unclear whether individuals are attracted to the light or if they are attracted to the prey that congregate under the lights (Perry et al. 2008). If amphibians are attracted to construction lighting, displacement within the Project activity zone is expected to increase.

14.3.2.3 Migratory birds

Loud construction-related activities, such as drilling, blasting, helicopter use, pile driving, and tree falling, would disturb migratory birds. The magnitude of disturbance to any species would depend on the type of activity, how close the activity is to the individual, the frequency of the activity, and the species' susceptibility to disturbance (Miller et al. 1998; James and Stuart-Smith 2000; Environment Canada 2011). Ongoing industrial noise and human use has the potential to reduce species diversity, change population age structure, and may alter avian predator-prey dynamics (Francis et al. 2009). This may be due to anthropogenic noises masking mate-attracting calls (Pohl et al. 2009; Rheindt 2003), communication with other flock members and offspring (Leonard and Horn 2005; Slabbekoorn and Ripmeester 2008), or defending territories and detecting predators (Francis et al. 2009; Habib et al. 2007).

Lighting at construction sites may also affect birds in migration as well as choice in nesting location (De Molenaar et al. 2006; also, van de Laar 2007, cited in Kociolek et al. 2011). Artificial lights can attract nocturnally migrating birds which can alter flight paths, resulting in depletions of energy stores (van de Laar 2007, cited in Kociolek et al. 2011) and may result in fatal collisions with neighbouring structures (Ogden 1996).

During operations, maintenance activities near the dam and along the transmission line could disturb birds that forage, roost, or nest around the Project infrastructure. The extent of disturbance or displacement is dependent on the timing and type of activities planned. Activities in the breeding season and during spring and fall migration would cause greater disturbance than activities occurring in the winter.

Clearing of vegetation during the breeding season could cause disturbance or destruction of active nests, resulting in increased stress, increased energy expenditure, changed behaviour, and potential abandonment of the nest.

14.3.2.4 Non-Migratory Game Birds

Noise and physical disturbance from construction machinery, equipment, and a large work force have the potential to disturb or displace grouse. Documented disturbance of Sharp-tailed grouse includes a variety of sources: human presence, all-terrain vehicles, mowing, livestock presence, and hunting dog training and trials (Leupin 2003). Male Sharp-tailed Grouse have previously been described as having a high tolerance for disturbance of their leks, returning once a disturbance has ceased; female Sharp-tailed Grouse consistently avoided leks located near disturbed areas, possibly leading to a reproductively inactive lek if only males are present (Baydack and Hein 1987). Individuals using two leks, one adjacent to the Highway 29 realignment and one adjacent to Area E, have the potential to be displaced due to Project activities.

Similar to migratory birds, clearing of vegetation during the breeding season could cause disturbance or destruction of active nests, resulting in increased stress, increased energy expenditure, changed behaviour, and potential abandonment of the nest.

14.3.2.5 Raptors

Loud construction-related activities such as drilling, blasting, helicopter use, pile driving, and tree falling could disturb raptors. The magnitude of disturbance would depend on the type of activity, proximity of activity, frequency of activity, and species' susceptibility to disturbance (Environment Canada 2011). Bald Eagles are particularly sensitive to disturbance during the early stages of nesting, including courtship, nest building, and egg-laying (U.S. Fish and Wildlife Service 2007), although eagles would often acclimatize to the disturbance if it is perceived to be non-threatening. Based on 2011 surveys for Bald Eagle nests, there is one nest downstream of the dam site within 500 m of the proposed dam site and one nest along Boucher Lake that is within 500 m of the existing 138 kV transmission line. All other known Bald Eagle nests not removed during construction are greater than 500 m from the Project activity zone, and not expected to be affected by project activities. Other species with nests within 500 m of the Project activity zone include Broad-winged Hawk (one nest) and Northern Goshawk (three nests). In the absence of mitigation, individuals using these nests could be affected by activities.

While forested habitat would be removed prior to filling the reservoir, raptors may still build or utilize existing nests in remaining forest patches within and adjacent to the proposed reservoir. These individuals would be displaced once the reservoir is filled.

Increased competition for foraging areas and nesting sites could occur as resident populations are displaced into neighbouring areas. This could be for either foraging areas or nesting sites. Some raptors may have increased predation risk from larger, more adaptable raptor species.

During operations, maintenance activities near the dam and along the transmission line could disturb raptors using the Project infrastructure, e.g., transmission towers, for roosting or nesting.

14.3.2.6 Mammals

14.3.2.6.1 Bats

Noise and physical disturbance from construction machinery or other sources has the potential to disturb bats. Construction noise, including blasting within 300 m of bat hibernacula during the winter, can cause premature arousal of hibernating bats. Disturbed bats burn through their energy reserves and can die of starvation before the end of winter. One arousal episode is estimated to cost the energetic equivalent of 68 days of hibernation (Thomas et al. 1990). Female bats that emerge from hibernation with insufficient fat reserves may be unable to reproduce that year (Holroyd 1993). Noise and vibration disturbance effects on day roosts used by small numbers of non-reproductive bats are likely negligible, as long as the structural integrity of the roost remains. Laboratory experiments suggest that some foraging bats avoid areas subject to noise such as road traffic (Schaub et al. 2008).

The potential use of white lights opposed to orange lights during construction and operation could lead to an increased concentration of aerial insects, which has been documented to result in an increased level of bat foraging activity (Blake et al. 1994). Other studies have shown drastic reductions in bat activity for certain species of bats in

the presence of artificial lighting, affecting the onset of commuting behaviour (Stone et al. 2009).

14.3.2.6.2 Beaver

Beaver would be displaced during reservoir clearing, flooding during Stage 1 and Stage 2 construction, and reservoir filling. Displacement may be temporary or permanent, and individuals would either move over land, downstream or upstream, or recolonize the edge of the reservoir.

The timing of water releases downstream during operations has the potential to disrupt beaver activity immediately downstream of the dam. Effects would lessen as the fluctuations in water levels attenuate. Beavers are susceptible to this level of disturbance due to current water management regimes along the river. As such, a measurable effect during operations is not anticipated.

14.3.2.6.3 Fisher

Fishers are less tolerant of open areas that limit prey availability, movement, and security. The clearing of land within the reservoir and other Project components would displace animals out of their traditional home ranges. Fishers tend to maintain intrasexually exclusive home ranges in which home ranges of members of the same sex very rarely overlap (Weir 2003). Home range overlap was observed between the female fishers with 95% Fixed Kernel home range estimates, indicating that some females in the general area do not maintain intrasexually exclusive home ranges.

14.3.2.6.4 Ungulates

Construction and clearing activities are expected to have the greatest effect on ungulates during the winter season, when most ungulates are confined to smaller geographic areas within their annual ranges. Disturbance can cause animals to relocate to less suitable habitat or onto agricultural land (Canfield et al. 1999). Once the forested areas within the reservoir have been cleared, the shrub-dominated communities could provide a considerable amount of browse. Fluctuations in water levels during construction of the dam may displace individuals into adjacent habitats. The extent of displacement would be dependent on the extent of flooding and the season.

Vehicular noise is likely the largest contributor to ungulate avoidance of roads. Visual disturbance and deleterious substances also contribute to road avoidance by ungulates. A variety of large mammals have lower population densities within 100–200 m of roads (Forman and Alexander 1998). Roads also provide improved access for hunters and poachers (James and Stuart-Smith 2000; Nellemann et al. 2001; Vistnes and Nellemann 2001; Nalcor Energy 2009), and possibly carnivores.

14.3.2.6.5 Large Carnivores

~~Disturbance and displacement of large carnivores due to Project activities is not expected.~~ Decreased wolf use is expected due to construction noise and the presence of vehicles and construction crews. Radio-collared wolves in Banff, Kootenay and Yoho National Parks avoided areas within 400 m of human activity but neither selected nor avoided areas more than 400 m away, despite the level of activity (Rogala et al. 2011). In areas where wolves are not persecuted, they may become much more tolerant of human activity (Thiel et al. 1998), but negative human attitudes towards wolves may

impede dispersal and gene flow even in the absence of physical barriers to movement (Stronen et al. 2011).

The effects of roads on habitat use by grizzly bears are variable. Grizzly bears have been reported to be displaced from habitats close to roads and to construction sites (McLellan and Shackleton 1989; Waller and Servheen 2005) but some studies have reported grizzly bears selecting habitats close to roads irrespective of traffic levels, possibly because of the forage opportunities present (Roever et al. 2008; Roever et al. 2010).

14.3.3 Effects Assessment – Mortality During Construction and Operations

14.3.3.1 Butterflies and Dragonflies

Mortality is anticipated for all life stages of butterflies and dragonflies: egg, larva, and adult. The greatest mortality risk is associated with the alteration of habitats due to construction activities, flooding, including temporary inundation, and the release of deleterious substances. In addition, the introduction of fish into wetlands that were previously without fish can decrease invertebrate populations, as fish can be predatory to larvae (Cannings et al. 2011).

Almost 500 ha of potentially suitable aquatic habitat, including wetlands, would be lost due to the filling of the reservoir. Headpond flooding during construction would include some of this same area. The timing of activities would influence the overall effect on various species, although flooding of aquatic environments can eliminate dragonfly larvae and eggs regardless of the time of year (R. Cannings., Royal B.C. Museum, 2012. pers. comm.).

14.3.3.2 Amphibians and Reptiles

Mortality is anticipated for all life stages of amphibians and snakes. The larger mortality risk is associated with the alteration of habitats during construction activities, flooding including temporary inundation, and the release of deleterious substances into aquatic habitats. Adults have a limited flight response and may not be able to escape these events.

In late summer, juvenile western toads (toadlets) congregate in large numbers along the sides of breeding pools before dispersing (COSEWIC 2002). Roadways that cut through core habitat areas or dispersal corridors and lack appropriately sighted exclusion fencing and amphibian or wildlife passage structures lead to increased levels of vehicle-induced mortality and population fragmentation (deMaynadier and Hunter, Jr. 1995; Waye 1999; Marsh et al. 2005; Eigenbrod et al. 2008). Road mortality is also a factor for snakes, as they are attracted to the sun-warmed road surface for thermal regulation in evenings (Shine et al. 2004).

Clearing of riparian vegetation and the movement of large construction machinery within or adjacent to riparian areas during construction may cause direct mortalities to amphibians and reptiles. Blasting through rock cliffs, rock outcrops, and talus slopes may result in direct mortality to snakes by potentially removing hibernacula and thermal habitats.

Deleterious substances, including herbicide, can be harmful to amphibians and snakes. Amphibians are considered more susceptible to environmental contamination than many other species (Geer and Krest 2000). Herbicides are known to cause mortality in amphibians if they are exposed at sufficient concentrations of the herbicide (Edginton et al. 2004; Chen et al. 2004; Relyea 2004, 2005a, 2005b, 2005c, 2006). Uncertainty and debate surround the potential direct effects of herbicides to amphibians, particularly what concentration of herbicide leads to measurable increases in mortality and whether this concentration can be found following industrial herbicide applications (Thompson et al. 2006; Relyea 2006). Toxicity of herbicides is often dependent on the herbicide's main ingredient, the surfactant used, and the amphibian species exposed (Howe et al. 2004).

14.3.3.3 Migratory birds

Direct and indirect mortality to individuals – including adults, chicks, and eggs – is expected to occur for most species. The greater mortality risk is associated with the alteration of habitats due to construction activities and flooding, including temporary inundation during dam construction. Other sources of mortality from the Project include deleterious substance releases and collision risk.

Mechanical vegetation removal and the timing of vegetation maintenance are of concern to migratory birds if activities are planned during the breeding season. The initial clearing for the reservoir can provide nesting habitat for ground- and shrub-nesting birds. These same areas have the potential for flooding during Stages 1 and 2 of dam construction, which would cause mortality to eggs and chicks. The extent of flooding would be dependent on the amount of water within the system, flow releases from the Peace Canyon Dam, and natural inputs from tributaries.

Road mortality associated with traffic is dependent on timing of activities and location of the road in relation to migratory bird use (Ascensao and Mira 2005). This can either be when birds cross the road or, in the case of Common Nighthawkroost, on the road (COSEWIC 2007).

Migratory bird mortality caused from bird/power line interactions is a result of either electrocution or collision, although electrocution is more common with distribution lines than transmission lines (Bradley 2003; Avian Power Line Interaction Committee 2006). This is because the spacing between two energized conductors and between a conductor and the support structure on transmission lines is too great to provide an opportunity for electrocution.

Factors influencing collision risk include the design layout of the power line, species-specific bird behaviour, and bird population densities. The chance of collision increases if the power lines bisect seasonal or daily migration paths, such as shorelines and wetlands (Dorin and Spiegel 2005).

Nocturnal or diurnal periods of activity (Bevanger 1994), in-flight manoeuvrability, and the altitude at which birds fly all affect collision potential (Dorin and Spiegel 2005). According to McNeil (1985) and Bevanger (1994), power lines located between feeding areas and roosting sites for wetland birds can have increased risk of bird collision, particularly when a short distance separates the two, as birds must make a short flight at a critical height. Inexperienced birds or birds exhibiting territorial or courtship behaviour can also be at higher risk of collision (Avian Power Line Interaction Committee and U.S. Fish and Wildlife Service 2005) as a result of decreased alertness.

Bird collisions are generally a result of poor visibility of suspended wires. Many collisions occur at the thinner, less visible overhead static lines (Savereno et al. 1996; Avian Power Line Interaction Committee and U.S. Fish and Wildlife Service 2005). Static wires act as safeguards to protect against power outages caused from lightning strikes. These lines are particularly difficult to see during fog, rain, snow, or other weather conditions that decrease overall visibility.

Many empirical studies find that, for most species involved in collisions, the death rate at the population level is low (e.g., Beaulaurier 1981; Brown 1993; Faanes 1987; Hugie et al. 1993). That said, small populations of rare or endangered species can be highly

susceptible to anthropogenic mortality (Bevanger 1994; Drewien 1973; Janss and Ferrer 1998; Lockman 1988; Savereno et al. 1996).

14.3.3.4 Non-Migratory Game Birds

Direct and indirect mortality to non-migratory game birds – including adults, juveniles, and eggs – is expected to occur. The greatest mortality risks are associated with alteration of habitats due to construction activities and flooding, including temporary inundation. Eggs and pre-fledged juveniles would be unable to escape these mortality risks. Initial clearing of the inundation zone is planned to take place outside the breeding season. Grouse may move into this area the following spring, as suitable areas for ground nesting are anticipated. Nests located within areas flooded annually upstream of the dam would be lost.

Direct mortality would result from collisions with equipment, machinery, and vehicles. Road access would bisect areas grouse frequent, and road mortality would be anticipated. Hunting pressure on grouse may increase with increased human presence along temporary roads used during construction.

14.3.3.5 Raptors

Direct and indirect mortality to individuals – including adults, juveniles, and eggs – is expected to occur. The greatest mortality risks are associated with alteration of habitats due to construction activities and flooding, including temporary inundation. Eggs and pre-fledged chicks are immobile and unable to escape, although initial clearing of the inundation zone is planned to take place outside the breeding season for raptors, minimizing the risk. Any nests located within areas flooded annually upstream of the dam – notably ground nests, such as those of Northern Harrier and Short-eared Owl – would be lost.

Direct mortality to raptors would result from collisions with equipment, machinery, and vehicles. Supporting literature suggests that vehicular collisions are a noteworthy source of mortality (Loos and Kerlinger 1993; Massemin and Zorn 1998; Hager 2009). Some raptor species, such as hawks and falcons, may be attracted to roads because of the availability of perches and the productivity of road verges, rather than the availability of roadkills (Dean and Milton 2003).

Mortality caused from raptor and power line interactions occurs as a result of either electrocution or collision. Electrocution is more common with distribution lines than transmission lines (Bradley 2003; Avian Power Line Interaction Committee 2006), as the spacing between two energized conductors and between a conductor and the support structure on transmission lines is too great to provide an opportunity for electrocution. Transmission lines are thought to have a greater collision risk than distribution lines based on the principle that the higher the lines are above ground, the greater the risk (Dorin and Spiegel 2005; Heck 2007). The number of vertical levels on a power line and the line height in direct relation to the surrounding landscape – e.g., through grassland or above the treetops – may increase the risk of collision (Bevanger and Brøseth 2001; Bradley 2003; Avian Power Line Interaction Committee and U.S. Fish and Wildlife Service 2005).

14.3.3.6 Mammals

Direct and indirect mortality to both adults and young is expected. The highest mortality risk is associated with the alteration of habitats due to construction activities and flooding, including temporary and permanent inundation. Species or life stages with limited mobility may not be able to move fast enough or far enough to escape flooding and construction activities. The initial clearing within the reservoir may leave some habitat for dens or lodges. These would be flooded during Stage 1 and 2 of dam construction, potentially causing mortality.

Other sources of mortality include vehicular collisions and increased access for hunting or poaching.

14.3.3.6.1 Bats

Destruction or disturbance of hibernacula in the winter has a high mortality risk for bats. Bats may be using the exposed rock at the proposed quarry site at Portage Mountain for hibernation between late August and May. Physical alteration and removal of the exposed rocks during the winter could crush hibernating bats or cause them to rouse in mid-winter. Bats that emerge during unfavourable winter conditions are likely to perish.

Excavation of cutbanks or removal of rock cliffs could potentially trap bats in roosts or crush individuals (Hayes and Loeb 2007). Buildings in the flood zone may have bats occupying them, and building demolition may cause mortality to adults and pups, especially if buildings used as maternity roosts are demolished before the pups are able to fly.

Clearing treed habitat during the growing season may result in mortality to bats as roost trees are felled. Non-volant pups are particularly vulnerable to felling of maternity roost trees.

Chemical use could negatively affect bats if their insect prey has eaten vegetation sprayed with herbicides, but the chronic exposure to contaminants is unlikely, due to the size of bat foraging areas (Bautista 2005; Baron et al. 1999). Bats may be killed by collisions with vehicles, but there are minimal data available regarding the frequency of roadkills. Russell et al. (2008) described roadkills of little brown bats in Pennsylvania, but that study involved thousands of bats observed crossing a heavily trafficked highway. Potential effects of roadkills on bats in the Peace River valley are unknown.

14.3.3.6.2 Beaver

The majority of beaver habitat in the LAA is along larger river systems, wetlands, and lakes. Much of the available habitat along the Peace River would be flooded by the reservoir. Construction headpond flooding of the reservoir may result in direct mortality of young kits if flooding occurs during the breeding season (late spring to early summer). Flooding during the fall has the potential to decrease winter beaver survival rates, due to losses of food caches.

The release of deleterious substances into waterways has the potential to cause mortality.

14.3.3.6.3 Fisher

Direct mortality due to vegetation clearing has the potential to occur, especially when trees are used for denning and resting. Denning females with kits would be particularity susceptible if clearing is competed during rearing period when kits are present and immobile (March 20–June 30).

Additional mortality could occur with increased heavy traffic on current and proposed roads, particularly in high-speed areas. Forest access roads or trails may also be used as travel corridors for predators, increasing the fisher's vulnerability to predation (Naney~~cy~~ et al. 2012).

14.3.3.6.4 Ungulates

Adult ungulates are highly mobile and are also adept at swimming, although debris, ice shelves, riprap, and other barriers may prevent ungulates from leaving the water after swimming and may result in drowning. Juveniles, within the first month of life, may be vulnerable to drowning if the areas they occupy are flooded in the spring (LeResche 1968; Ballard et al. 1981).

Equipment and materials movement by road or train are expected to result in collision mortalities, particularly if transport routes traverse areas with high numbers of ungulates. Numbers of collisions are influenced by the frequency and speed of traffic, and by the time of day (Klinkenberg 2012). Roadkills occur frequently on existing highways and they would increase with upgrading of highways and increased traffic. Hunting and illegal poaching are also considered a concern associated with increased access (Blood 2000).

14.3.3.6.5 Large Carnivores

The risk of bear mortality due to human ~~defence~~defense of life and property would increase in construction areas in proximity to food sources, or to other attractants such as road-killed ungulates or garbage. Improper handling of waste disposal and treatment is known to create nuisance wildlife and negative human-bear interactions. This is more of a concern with black bears, but could also occur with grizzly bears, where they occur in the LAA.

Mortality to young wolf pups may result from reservoir filling if reproductive dens are located within the reservoir footprint. The Livestock Protection Pilot Program currently pays a bounty on wolf carcasses in developed areas of the Peace Region (MacArthur 2013), and this, in conjunction with the regional open hunting season on wolves below 1100 m, will form the bulk of human-caused wolf mortality in the vicinity of the Project.

Similar to ungulates, collisions with bears and wolves are expected to continue to occur. Increased hunting and illegal poaching associated with changes in road access is also a concern.

14.4 Mitigation Measures

This assessment proposes technically feasible mitigation measures to address potential Project effects on wildlife resources during construction and operations. Avoidance measures can include refining Project boundaries and selecting the most appropriate construction methods, equipment, material, and timing of activities. Additional mitigation measures to consider include environmental protection measures such as establishment

of no- or restricted-activity buffer zones around wildlife features, Best Management Practices (BMPs) and protocols, and engineering standards. Where feasible, mitigation measures can be refined based on consultation with federal and provincial regulatory agencies and Aboriginal groups. Table 4.1 in Section 4.1 Project Evolution in Volume 1 Section 4 Project Description summarizes changes that have been incorporated into the project design to avoid or mitigate potential Project-related effects.

14.4.1 Mitigation for Habitat Alteration and Fragmentation

The potential adverse effects of permanent habitat loss to wildlife resources cannot be avoided within the reservoir and much of the dam, generating station, and spillways, although they can be measurably reduced for other Project components, e.g., transmission line and roads, during final design. This would include placing transmission towers and access roads away from wetlands unless it is proven that no other design option is feasible. The placement of the transmission lines over wetlands and other non-forested areas would not alter the habitats, as only minor clearing would be required during either construction or operations.

The areas within the Project activity zone have already experienced varying levels of habitat fragmentation associated with forestry, agriculture, oil and gas, and urban development. Efforts on this Project have been made to use existing corridors, deactivate temporary access roads, and minimize disturbance where possible, to help minimize fragmentation. Project components where this has occurred include:

- **Substation and Transmission Lines to Peace Canyon Dam:** building the transmission lines adjacent to the existing line, therefore using the existing corridor and maintenance access roads
- **Highway 29 Realignment:** use portions of existing roads and select borrow sites that already exist or would be covered by the reservoir
- **Quarried and Excavated Construction Materials:** further develop existing quarry sites such as Wuthrich, Del Rio, and West Pine, and use a site that has already seen development – the 85th Avenue Industrial Lands.
- **Road and Rail Access:** use existing infrastructure for moving material, upgrade existing access roads, and deactivate temporary roads used for reservoir clearing, and place the Project access road to the dam site area along the existing transmission line corridor

Mitigation measures to be implemented to reduce the effect of Habitat Alteration and Fragmentation are outlined in Table 14.15.

Table 14.15 Mitigation Measures for Habitat Alteration and Fragmentation

Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
Construction and operations	Habitat alteration and fragmentation: ▪ Wetlands and wetland-associated key indicators: amphibians and reptiles, butterflies and dragonflies, migratory birds, raptors, bats	All known wetland locations (e.g., breeding habitat for butterflies and dragonflies, amphibians, migratory birds), snake hibernacula, bat hibernacula, Sharp-tailed Grouse lek sites, beaver lodges, and large raptor stick-nest locations would be provided as inputs during the final design phase so further reductions and avoidances can be considered. If work is required immediately adjacent to any wetlands, then appropriate barriers and no- or restricted-activity buffer zones would be established to avoid direct disturbance to these sites. Habitat would be cleared in the approved areas only and construction would be monitored to prevent any unnecessary clearing. Construction and maintenance activities in and around watercourses and wetlands would conform to BC Hydro's regulator-accepted practices including Approved Work Practices for Managing Riparian Vegetation (BC Hydro et al. 2009). New wetland habitat areas would be created as partial compensation for wetland loss due to the reservoir. Consideration for creating areas that are fish-free would be included to minimize the effects of fish predation on invertebrate and amphibian eggs and larvae and young birds.	Recommended mitigation measures would reduce but not fully mitigate the potential effects of the Project	BC Hydro
Construction and operations	Habitat alteration and fragmentation: ▪ Wetlands and wetland-associated key indicators: amphibians and reptiles, butterflies and dragonflies, migratory birds, raptors, bats	Maintaining surface flow patterns is important in the retention of functioning wetlands. Measures would be implemented to maintain existing hydraulic patterns as much as possible if roads cannot avoid wetlands. Ditches, culverts, and other structures would be placed to maintain the natural drainage patterns and allow the movement of flows.	Effective with proper consideration for flow maintenance; monitoring with adaptive management may be required	BC Hydro

Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
Construction and operations	Habitat alteration and fragmentation: all key indicators: ▪ Introduction of deleterious substances ▪ Erosion and sedimentation ▪ Hydrocarbon and hazardous materials management ▪ Invasive species management	Construction and maintenance activities in and around watercourses and aquatic habitats would conform to BC Hydro's accepted work practices with additional input from Standards and Best Practices for Instream Works (B.C. Ministry of Water, Land and Air Protection 2004b) and the Land Development Guidelines for the Protection of Aquatic Habitat (Chilibeck et al. 1992), which are designed to reduce sedimentation and avoid introduction of deleterious substances to aquatic environments. BC Hydro would have an Erosion Prevention and Sediment Control Plan (Section 35.2.2.9 in Volume 5 Section 35 Summary of Proposed Environmental Management Plans) as part of their Construction Management Framework. Stripping vegetation and soils would be minimized as much as possible, taking into consideration proximity to sensitive habitats, e.g., wetlands, and slope stability. Within the reservoir, a hierarchal decision matrix has been developed for clearing to reduce erosion potential along steep, unstable slopes and along riparian zones for all defined watercourses. Specifically, the decision matrix includes: ▪ Retention of all trees in areas with steep, unstable slopes that would be highly susceptible to landslides if the vegetation was removed ▪ Retention of non-merchantable trees and vegetation within riparian areas around existing water bodies within a 15 m buffer from the high water mark. Merchantable trees may still be removed using clearing practices, in order to maintain a 15 m machine-free zone. These same standards would be employed in other work areas and would follow BC Hydro's approved work practices. Stormwater management would aim to control runoff and direct it away from work areas where excavation, spoil placement, and staging activities occur. Consideration for maintaining recharge levels to wetlands would be considered when diverting water around work sites, providing there is not expected to be a measurable increase in sediment transport to these sensitive areas. A Surface Water Quality Management Plan (Section 35.2.2.21 in Volume 5 Section 35 Summary	Effective – measures based on accepted work practices	BC Hydro

Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
		of Proposed Environmental Management Plans) would be developed as part of BC Hydro's Construction Environmental Management Framework. Cleared areas that will not have permanent features would be replanted with appropriate vegetation in order to promote soil stability. Regionally appropriate vegetation would be included in the reclamation activities. BC Hydro would develop a Soil Management, Site Restoration and Revegetation Plan (Section 35.2.2.19 in Volume 5 Section 35 Summary of Proposed Environmental Management Plans). All activities that involve potentially harmful or toxic substances, such as oil, fuel, antifreeze, and concrete, would follow approved work practices and consider the provincial BMP guidebook Develop with Care (B.C. Ministry of Environment 2012). BC Hydro would have a Fuel Handling and Storage Management Plan (Section 35.2.2.11 in Volume 5 Section 35 Summary of Proposed Environmental Management Plans). This plan would include the need for all construction machinery and vehicles to be properly maintained to ensure that harmful fluids do not leak into aquatic environments or other sensitive areas. Prior to initiating construction activities in proximity to any water body, the hydraulic, fuel, and lubrication systems of all equipment would be checked to ensure that systems are in good condition and free of leaks. All machines would have a spill kit and operators would be educated on how to use the kit. Minimum distances between maintenance and refuelling sites and water bodies would be specific in the plan. BC Hydro's Construction Environmental Management Framework would include an Emergency Response Plan (Section 35.2.1.1 in Volume 5 Section 35 Summary of Proposed Environmental Management Plans) as well as a Hazardous Waste Management Plan (Section 35.2.2.13 in Volume 5 Section 35 Summary of Proposed Environmental Management Plans). Herbicide application would be used to control invasive plants and for the maintenance of some vegetation along the transmission line and at project facilities. The use of herbicides is described in BC Hydro's Pest Management Plan for Management of Vegetation at BC Hydro Facilities (BC Hydro 2012) and Integrated Vegetation Management Plan for		

Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
		Transmission Rights-of-way (BC Hydro 2010). Disturbed sites would be replanted quickly with ground cover, shrubs, or trees that are regionally appropriate, once erosion concerns have been addressed per BC Hydro's Soil Management Site Restoration and Revegetation Plan. A Wildlife Management Plan (Section 35.2.2.24 in Volume 5 Section 35 Summary of Proposed Environmental Management Plans) and Vegetation and Invasive Plant Management plan (Section 35.2.2.22 in Volume 5 Section 35 Summary of Proposed Environmental Management Plans) would also be included, defining objectives for limiting invasive species by monitoring the presence and possible spread of invasive plants in temporarily disturbed areas, as well as the success of revegetation programs. Mitigation measures to reduce the spread of invasive species include: ▪ Prior to work commencing, surveys would be conducted to identify invasive species populations. Treatment would be initiated as required ▪ All vehicles entering and leaving work sites would be washed thoroughly, with special attention to wheel wells, tire treads, and tracks where mud and seeds of noxious weeds may be lodged ▪ Locating wash areas away from any water body and riparian areas ▪ Treating used wash water to prevent seed dispersal The Pest Management Plan for Management of Vegetation at BC Hydro Facilities (BC Hydro 2012) and the Integrated Vegetation Management Plan for Transmission Rights-of-Way (BC Hydro 2010) would be followed in order to reduce or avoid the spread of invasive species during the operations phase of the Project.		
Construction	Habitat alteration and fragmentation: ▪ Loss of snake hibernacula	As mitigation for the loss of snake hibernacula, artificial dens would be considered during habitat compensation. These artificial dens would be located on warm aspect slopes in open areas away from major roads.	Effective, on a limited scale	BC Hydro

Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
Construction	Habitat alteration and fragmentation: ▪ Loss of nesting habitat: migratory birds	Nest boxes for cavity-nesting waterfowl would be incorporated into wetland mitigation plans. Additional boxes would be established within riparian vegetation zones established along the reservoir on BC Hydro-owned properties, where feasible. The feasibility of placing small floating islands along some areas within the reservoir would be examined. Based on present land ownership, it is estimated there would be over 300 ha of BC Hydro-owned Cultivated Field remaining after the reservoir is filled. A portion of these fields would be managed to provide some breeding habitat for Northern Harrier and Short-eared Owl. Wetland compensation would also address some habitat losses for these two species.	Limited in scale, but can be effective	BC Hydro
Construction	Habitat alteration and fragmentation: ▪ Bats	Bat roosting habitat features would be considered for incorporation into new bridge designs. This can be achieved following published guidelines (Keely and Tuttle 1999; Johnston et al. 2004; Gore and Studenroth 2005) without compromising bridge safety or structural integrity. Bridge night roosts are currently the only public sites within the Peace River valley where relatively large numbers of bats can be captured in a night. Bat boxes may be installed on free-standing poles or on facility walls where their presence would not interfere with facility operations and maintenance. The feasibility of incorporating bat boxes onto mounting poles being used for artificial eagle nest sites would be examined. Bat boxes should be situated where they will get at least 10 hours of sun to provide warm conditions for maternity roosts. Additional information on design, construction, and installation of bat boxes is available from Bat Conservation International (2012). Balsam poplar and aspen would be considered in plantings when reclaiming disturbed habitats and when enhancing habitat for wildlife compensation. Deciduous trees would provide future roosting habitat for bats. Once rock extraction is complete at Portage Mountain, opportunities for creating hibernating and roosting sites would be explored. This can include leaving deep drill holes at least 3 m deep in remaining rock	Installation of bat boxes around dams and generating stations has proven to be successful at providing bat habitat features at other BC Hydro facilities (Nagorsen 2009) Limited in scale	BC Hydro

Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
		faces, and creating roost microsites on warm aspects that are inaccessible to predators.		
Construction and operations	Habitat alteration and fragmentation: ▪ Fisher	The fisher population, particularly south of the Peace River, is lower than initial estimates, based on habitat availability and provincial density. Throughout its range, fur harvest, timber harvest, predator control, and urbanization have been the greatest contributors to fisher population declines (Lofroth et al. 2010). Mitigation measures that limit these factors may increase the population. Create natural or artificial piles of coarse woody debris dispersed throughout the disturbed landscape to maintain foraging areas and cold-weather rest sites. Focus on younger plateau forest where coarse woody debris is limited. Create arboreal resting sites. Spruce rust broom was found to be rare in the Peace River valley, primarily due to the lack of coniferous forests. Creating rust broom-like structure in deciduous stands may provide additional resting opportunities for fisher. Provide artificial den boxes within forested stands that have limited den trees.	Limited in scale, but may be effective	BC Hydro
Construction and Operations	Habitat alteration and fragmentation: ▪ Ungulates	BC Hydro would continue to manage lands it owns to the east of the Halfway River and west of Wilder Creek to maintain values of these areas as winter range and their accessibility. ~~Other jurisdictions have implemented supplemental feeding programs to support ungulate populations during severe winter conditions. It is a method commonly used in the western United States for mule deer and elk (Baker and Hobbs 1985; Smith 2001; Peterson and Messmer 2007). Supplemental feeding has also been used for moose in Alaska and Scandinavia (Van Beesta et al. 2010). Such programs require careful planning and management by experienced biologists in order to be effective (Putman and Staines 2004). They can be costly, depending on the size of the area and numbers of animals. The use of feeding programs during severe winters would be considered.~~	Limited in scale, but may be effective	BC Hydro

14.4.2 Mitigation for Disturbance and Displacement

The avoidance and reduction of displacement due to construction headpond flooding is not possible, as the timing of flooding is dependent on natural events (e.g., rainfall and the spring freshet) and power generation. Effects may be alleviated with the creation of habitats within the reservoir and the creation of some additional habitats through compensation works.

Mitigation measures to reduce the effect of disturbance and displacement from the Project are outlined in Table 14.16.

Table 14.16 Mitigation Measures for Disturbance and Displacement

Project Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
Construction and Operations	Disturbance and displacement: ▪ Migratory birds, non-migratory birds, raptors ▪ Timing of works ▪ Lighting ▪ Roads	The clearing of vegetation for all work would consider both the *Migratory Bird Convention Act* and the B.C. *Wildlife Act,* where active nests are protected from disturbance and removal. The provincial government has developed least-risk windows for terrestrial wildlife that are of management concern within the Peace Region of the B.C. Ministry of Forests, Lands and Natural Resource Operations. Suggested critical time periods when construction should be avoided are: ▪ Songbirds: May 1 through July 31, when nesting could occur (B.C. Ministry of Forests, Lands and Natural Resource Operations 2011). ▪ Trumpeter Swan, raptors and owls: April 1 through July 31 Goddard (2010) observed lek attendance by Sharp-tailed Grouse between mid-April and mid-May in the Peace River region, and a nesting initiation to hatching date range from early May to mid-July. There is no specific mention for grouse within the least-risk windows, but nesting overlaps the critical time frame suggested for raptors. Clearing activities for much of the area are presently scheduled to occur during the winter months, thereby avoiding conflicts with nesting birds (see Volume 1 Appendix A Vegetation, Clearing, and Debris Management Plan). Scheduling constraints may require clearing activities to occur outside the winter months. If clearing work during the critical bird breeding season outlined above cannot be avoided, a nest and lek search protocol would be developed and implemented prior to clearing, to avoid disturbance to active nests. The protocol would be developed in consultation with Environment Canada, Canadian Wildlife Service, and the Ministry of Environment. The protocol would outline buffers required around active nest sites. As feasible, lighting would be focused on work sites, minimizing light pollution in surrounding areas. During construction, access would be restricted on roads used by work crews. Temporary roads would be closed and reclaimed when no longer needed.	Effect would be partially mitigated	BC Hydro

Project Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
Construction and Operations	Disturbance and displacement: ▪ Butterflies and dragonflies, amphibians and reptiles, migratory birds, non-migratory birds, raptors, bats, fur-bearers, ungulates, and large carnivores	BC Hydro uses a GIS-based mapping system for recording, storing, and analyzing information for managing resources along all of its rights-of-way. The information is reviewed when developing vegetation management prescriptions during operations. If occurrences for rare species (e.g., Yellow Rail) are known along the transmission line right-of-way or are adjacent to generation facilities, the location of these sites would be incorporated into the database for future planning and consideration, so as to minimize or avoid unnecessary disturbance.	Effects would be partially mitigated; is dependent on the extent of known occurrences	BC Hydro
Construction	Displacement and disturbance: ▪ Sharp-tailed Grouse	All known lek locations would be provided as inputs during the final design phase so further reductions and avoidances are considered. If new construction sites are added or the area where disturbance is to occur is poorly understood, the new areas would be checked to confirm if leks are present and possible ways to minimize disturbance. If work is required immediately adjacent to any leks, then appropriate barriers would be added so as to instruct construction personnel to avoid these sites. Habitat would be cleared in the approved Project activity zone only, and construction would be monitored to prevent any unnecessary clearing.	Effects partially mitigated; effectiveness depends on duration of construction activity and level of alteration around the lek	BC Hydro

Project Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
Construction	Disturbance and displacement: ▪ Bald Eagle nests	The baseline data on Bald Eagle nest sites from 2011 would be updated prior to commencement of construction to ensure an accurate understanding of the number of nests that would be affected by the Project. To mitigate the loss of Bald Eagle nests within the proposed reservoir, new nesting platforms would be erected along the expected reservoir shoreline. Platforms would be designed to be attractive to nesting Bald Eagles – i.e., platform suitable for supporting a large stick-nest, with structures extending above the platform to provide perch sites for adults and juveniles prior to fledging – and would be placed in areas removed from potential human disturbance. The Best Management Practices for Raptor Conservation during Urban and Rural Land Development in British Columbia (Demarchi et al. 2005) provides further guidance. For each active nest lost due to the Project, two nesting structures would be provided; the two-to-one ratio is proposed by BC Hydro. Bald Eagle nests are typically located adjacent to water. With construction lasting up to eight years, it is possible Bald Eagles would not use the newly erected platforms until the reservoir is filled. Bald Eagle nests confirmed active the year clearing is started within the reservoir, and outside the dam construction area would be retained through the entire construction phase until reservoir filling is initiated. Nests that could be lost during seasonal flooding associated with Stage 2 dam construction would be removed to limit displacement or possible mortality. Appropriate government approvals and permits would be obtained prior to removing any nest. For active nests retained through construction, a no-clearing buffer centred on each active nest would be employed.	Effects would be partially mitigated	BC Hydro

Project Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
Construction and Operations	Disturbance and displacement: ▪ Large carnivores	Preventative measures would be used to avoid creating human-bear conflicts. Before commencement of work, all crews should participate in a Bear Aware™ or similar training program. Feeding of wildlife (including birds) would be prohibited at work sites. Construction areas and worker housing sites would be fenced and kept clean and free of waste, with garbage securely stored in bear-proof containers or removed from site. Trucks and work vehicles are not secure storage areas for garbage, because bears have been known to break into vehicles for food (Davis et al. 2002). Work crews would be prohibited from hunting and cleaning game around construction sites. If precautions to remove bear attractants such as food and garbage are not effective in deterring aggressive bears from construction areas, the Environmental Monitor would notify a Conservation Service Officer that a potential "problem bear" is in the area. A bear would only be classified as a "problem bear" if: ▪ It shows repeated interest in people and their facilities ▪ It is heavily habituated to people and has repeatedly obtained unnatural foods ▪ It displays aggressive behaviour (unprovoked charges or predatory behaviour) and is an imminent threat to human safety The Conservation Service Officer would determine whether further actions, such as more aggressive aversive conditioning (e.g., use of rubber bullets, hard capture and release, etc.), translocation, or destruction of the bear are necessary, and would advise about how to ensure worker safety. A detailed Human-Bear Conflict Management Plan would be developed for the Project.	Effects would be partially mitigated	BC Hydro

14.4.3 Mitigation for Mortality

Mortality related to habitat loss cannot be fully avoided for the entire Project, but can be reduced with wetland avoidance along the transmission line when building access roads and by maintaining hydraulic patterns, should a road bisect a wetland. Mortality can also be reduced by clearing during times of the year that would pose the least risk to wildlife. Additional mitigation measures to reduce mortality on wildlife as a result of the Project are outlined in Table 14.17.

Table 14.17 Mitigation Measures for Mortality

Project Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
Construction and Operations	Mortality: ▪ Migratory birds, non-migratory birds, raptors ▪ Timing of works ▪ Collision and electrocution	The clearing of vegetation for all work would consider both the *Migratory Bird Convention Act* and the B.C. *Wildlife Act,* where active nests are protected. The provincial government has developed least-risk windows for terrestrial wildlife that are of management concern within the Peace Region of the B.C. Ministry of Forests, Lands and Natural Resource Operations (see above in Disturbance and Displacement mitigation). Clearing activities for much of the area are presently scheduled to occur during the winter months, thereby avoiding conflicts with nesting birds (see Volume 1 Appendix A Vegetation, Clearing, and Debris Management Plan). Scheduling constraints may require clearing activities to occur outside winter months. If clearing work during the critical bird breeding season outlined above cannot be avoided, a nest and lek search protocol would be developed and implemented prior to clearing to avoid disturbance and possible mortality to nesting birds. The protocol would be developed in consultation with Environment Canada, Canadian Wildlife Service, and the Ministry of Environment. The protocol would outline buffers required around active nest sites. The design of the transmission towers reduces the risk of collision and electrocution by: 1. BC Hydro's standard design has all of the conductors in the same horizontal plane. This configuration will be used unless there is a requirement to reduce the right-of-way. 2. The standard phase-to-phase spacing (distance between the lines) for 500 kV transmission lines is approximately 10 meters and phase-to-ground (conductors to the tower body) is over 3 meters so the risk of electrocution by contacting two phases or one phase and the tower is virtually non-existent.	Effect would be partially mitigated	BC Hydro

Project Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
Construction	Mortality: ▪ Butterflies and dragonflies, amphibians and reptiles, migratory birds, non-migratory birds, raptors, bats, fur-bearers, ungulates and large carnivores ▪ Introduction of deleterious substances ▪ Erosion and sedimentation ▪ Hydrocarbon and hazardous materials management ▪ Invasive species management	The project would avoid the release of deleterious hydrocarbons and other hazardous materials by conforming to BC Hydro's accepted work practices with additional input from Standards and Best Practices for Instream Works (B.C. Ministry of Water, Land and Air Protection 2004b) and the Land Development Guidelines for the Protection of Aquatic Habitat (Chilibeck et al. 1992), which are designed to reduce sedimentation and avoid introduction of deleterious substances to aquatic environments. Mortality due to sedimentation would be reduced or avoided following similar plans, e.g., BC Hydro would have an Erosion Prevention and Sediment Control Plan (Section 35.2.2.9 in Volume 5 Section 35 Summary of Proposed Environmental Management Plans) as part of their Construction Management Framework. Surface water quality would be monitored to ensure it does not exceed established guidelines for aquatic life (see Volume 2 Appendix E Water Quality Baseline Conditions in the Peace River). BC Hydro would follow their Pest Management Plan for Management of Vegetation at BC Hydro Facilities (BC Hydro 2012) and Integrated Vegetation Management Plan for Transmission Rights-of-Way (BC Hydro 2010) for the use of herbicides. This includes consideration for use around wetlands and species at risk.	Effects would be mitigated – as measures based on accepted work practices	BC Hydro
Construction and Operations	Mortality: ▪ Butterfly and dragonfly, amphibians and reptiles ▪ Predation	A portion of the wetlands created to compensate for habitat loss would be designed to remain fish-free to eliminate predation to invertebrates (dragonfly larva) and amphibians and reptiles.	Effect would be partially mitigated	BC Hydro
Construction and Operations	Mortality: ▪ Amphibians and reptiles, mammals ▪ Roads	Road mortality for both amphibians and snakes was documented during baseline studies and is expected to occur during Project construction, as many roads have multiple users. During detailed road design, efforts would be made to minimize or avoid additional losses. Where roads are adjacent to wetlands or amphibian migrations across roads are anticipated, fencing would be placed along the length	Effects would be mitigated with proper consideration for movements;	BC Hydro

Project Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
		of the road to guide amphibians through structures designed for wildlife passage under the road. The size and number of the structures needed and the length of fencing would be determined in consultation with regulators. Road mortality of mammals is expected to occur during Project construction. Measures to minimize road mortality include: ▪ Reducing vehicle traffic by using buses and car-pooling for workers ▪ Requiring workers to adhere to strict speed limits ▪ Instructing workers that wildlife has right-of-way unless there are safety concerns ▪ Maintaining a logbook of wildlife sightings, including roadkills, and posting warning signs at locations with frequent wildlife crossings ▪ Promptly moving roadkill well off the road to avoid secondary mortality of scavengers ▪ Including wildlife-vehicle collisions as safety issues for discussion on worker tailboard meetings Temporary workers involved in on-site Project construction would be encouraged not to hunt in the LAA.	monitoring with adaptive management may be required	
Construction and Operations	Mortality: ▪ Mammals ▪ Roads	Mammal mortality associated with filling the reservoir can be reduced by clearing forested habitat – potential roosting and cover sites for bats and fisher – before flooding begins. Clearing should take place during late fall and winter before the birthing season and when bats are not present or are in hibernacula. Scheduling of construction activities should follow guidance in Peace Region Selected Terrestrial and Aquatic Wildlife Least Risk Windows (B.C. Ministry of Forests, Lands and Natural Resource Operations 2011).	Effects would be partially mitigated	BC Hydro
Construction and Operations	Mortality ▪ Large carnivores	Preventative measures would be used to avoid creating human-bear conflicts. Before commencement of work, all crews should participate in a Bear Aware™ or similar training program. Feeding of wildlife (including birds) would be prohibited at work sites. Construction areas and worker housing sites would be fenced and kept clean and free of waste, with garbage securely stored in bear-proof containers or removed from site. Trucks and work vehicles are not secure storage areas for garbage, because bears have been known to break into vehicles for food (Davis et al. 2002). Work crews would be prohibited from hunting and cleaning game around construction sites.	Effect would be partially mitigated	BC Hydro

Project Phase	Project Effect	Mitigation Measures	Mitigation Effectiveness	Responsibility
		If precautions to remove bear attractants such as food and garbage are not effective in deterring aggressive bears from construction areas, the Environmental Monitor would notify a Conservation Service Officer that a potential "problem bear" is in the area. A bear would only be classified as a "problem bear" if: ▪ It shows repeated interest in people and their facilities ▪ It is heavily habituated to people and has repeatedly obtained unnatural foods ▪ It displays aggressive behaviour (unprovoked charges or predatory behaviour) and is an imminent threat to human safety The Conservation Service Officer would determine whether further actions, such as more aggressive aversive conditioning (e.g., use of rubber bullets, hard capture and release, etc.), translocation, or destruction of the bear are necessary, and would advise about how to ensure worker safety. A detailed Human-Bear Conflict Management Plan would be developed for the Project. Mitigation for wolves will include previously-described measures for minimizing road traffic, deactivation and reclamation of temporary construction roads, maintaining clean worksites and camps, and encouraging temporary workers to not hunt in the LAA. Filling the reservoir during the fall will prevent potential drowning of young pups. It should be noted that mitigation is not designed to promote increases in the wolf population as that would conflict with the current regional goal of reducing wolf predation on livestock and ungulates.		

14.4.4 Other Mitigation Options Considered

Avoidance and reduction measures have been employed to reduce wetland loss but removing Watson's Slough, and the associated marl fen, from the reservoir is not technically or economically feasible. Protection of Watson's Slough from inundation from the reservoir would have required a large berm several metres in height. The effectiveness of such a berm would be uncertain, and seepage from the reservoir and input from natural springs may have affected the slough.

14.5 Residual Effects

14.5.1 Characterization of Residual Effects

Although the mitigation measures summarized above would reduce the effects on wildlife resources, residual adverse effects remain for habitat alteration and fragmentation, disturbance and displacement, and mortality. The characterization of residual project effects assumes that the specific mitigation measures described above are all implemented.

Residual effects are not expected for large carnivores during construction or operations and are not discussed further.

The criteria used to characterize residual adverse effects are provided in Table 14.18.

Table 14.18 Characterization Criteria for Residual Effects on Wildlife Resources

Criterion	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The ultimate long-term trend of the effect relative to baseline case.	**Negative:** Condition of the VC is worsening in comparison to baseline conditions
		Positive: Condition of the VC is improving in comparison to baseline conditions
Magnitude	The amount of change in a key indicator or variable relative to baseline case.	**Low:** Less than 10% change
		Moderate: Between 10–20% change
		High: Greater than 20% change
Geographical Extent	The geographic area in which an environmental effect of a defined magnitude occurs.	**Site-Specific:** The extent of the effect will have sub-local implications to key indicators
		Local: The extent of the effect will have sub-population implications to key indicators within the LAA
		Regional: The extent of the effect will have broader population implications to key indicators
Duration	The period of time required until the VC returns to its baseline condition, or the effect can no longer be measured or otherwise perceived.	**Short-term:** Effect is limited to < 1 year
		Medium-term: Effect occurs > 1 year but only during construction
		Long-term: Effect lasts into Project operation but dissipates during the life of the Project
		Permanent: Effect lasts during the life of the Project and possibly beyond

Criterion	Description	Quantitative Measure or Definition of Qualitative Categories
Frequency	The number of times during a project or a specific project phase that an environmental effect may occur.	**Once:** Occurs once
		Continuous: Occurs on a regular basis and at regular intervals
		Weekly: Occurs on a regular basis within one month but is sporadic throughout a year
		Monthly: Occurs on a regular basis for more than a month, but is sporadic throughout a year
Reversibility	The degree or likelihood to which existing baseline conditions can be regained after factors causing the effect are removed.	**Reversible:** With reclamation and/or over time
		Irreversible: Over time, even with reclamation
Context	The extent to which the area effected has already been adversely affected by human activities, and is ecologically fragile with little resilience and resistance to imposed stresses.	**High resilience:** Area or key indicator persists when it is subjected to frequent natural or anthropogenic disturbances
		Low resilience: Area is relatively pristine with little or no recent disturbance, or the key indicator requires long-term ecosystem stability in order to thrive
Level of Confidence	An evaluation of the scientific certainty in the review of Project-specific data, relevant literature, and professional opinion.	**Low:** The effectiveness of mitigation or scale of the effect is poorly understood; follow-up monitoring is recommended
		Moderate: Greater certainty in understanding an effects outcome, but reflective of modelling confidence and an understanding of effect pathways
		High: Detailed modelling and an understanding of effect pathways are well understood
Probability	The likelihood that an adverse effect will occur	**Low:** An effect is unlikely to but may occur
		High: An effect is likely to occur

14.5.1.1 Habitat Alteration and Fragmentation

The Project would cause alteration and fragmentation of habitat used by key indicator species by the following mechanisms: i) changes to the structural stage of habitats, ii) loss or reduction in the area of individual habitats, iii) changes to connectivity between habitats, iv) changes in hydrology and flow patterns, v) release of deleterious substance, and vi) loss or reduction in specific habitat features such as nests, winter range areas, and hibernacula. Habitat alteration and fragmentation is considered the primary effect of the project on wildlife resources because the presence and use of the LAA by wildlife resources is driven by the presence and distribution of habitats.

Table 14.19 summarizes the characterization of the residual adverse effect of habitat alteration and fragmentation on all key species groups. An explanation of the characterization is provided by key indicator species group in the text that follows.

14.5.1.1.1 Butterflies and Dragonflies

Construction

The effects of habitat alteration and fragmentation would differ based on a species' habitat preferences.

Due to the range in losses, the magnitude during construction has been assessed as ranging from low to moderate. Geographic extent has been characterized up to regional, due to losses to habitat required by species considered at risk regionally. Most habitat alteration and fragmentation would occur once the clearing within the Project activity zone is completed. It is considered reversible in areas that would be revegetated or where habitats are compensated, and irreversible for suitable habitats that are affected and cannot be readily replaced. Some butterflies and dragonflies require long-term ecosystem stability to survive; portions of the Project activity zone are relatively pristine, while others are not; for this reason, context, the resilience of the key indicator, has been characterized as low. The level of species knowledge and certainty associated with species models leads to a confidence level ranging from moderate to high, depending on species. The probability of an adverse effect occurring is high.

Operation

A magnitude of low has been assessed for operations due to limited habitat alteration and fragmentation associated with erosion along the reservoir.

Table 14.19 Summary of Characterization of Residual Effects: Habitat Alteration and Fragmentation – Key Wildlife Species GroupsButterflies and Dragonflies

		Residual Effect: Habitat Alteration and Fragmentation								
Key Species Group	**Phase**	**Direction**	**Magnitude**	**Geographic Extent**	**Duration**	**Frequency**	**Reversibility**	**Context**	**Level of Confidence**	**Probability**
Butterflies and Dragonflies	Construction and Operations	Negative	Low to Moderate	Local to Regional	Permanent to Long Term	Once to continuous	Irreversible and Reversible	Low to	High to Moderate	High
Amphibian and Reptiles	Construction and Operations	Negative	Low to High	Local	Permanent to Long Term	Once to continuous	Irreversible and Reversible	Low and High	Moderate	High
Migratory Birds	Construction and Operations	Negative	Moderate Low to High	Site-Specific to Regional	Moderate Term to Permanent	Once to continuous	Irreversible and Reversible	Low to High resilience	Low to High	High
Non-migratory Birds	Construction and Operations	Negative	Low to Moderate	Local	Moderate Term to Long Term	Monthly to Continuous	Reversible	High resilience	Moderate to High	High
Raptors	Construction and Operations	Negative	Low to Moderate	Site-Specific to Local	Short term to Long Term	Once to Continuous	Reversible	Low to High resilience	Low to High	Low to High
Bats	Construction and Operations	Negative	Low to Moderate	Local	Permanent	Once	Irreversible	Low to High resilience	Low	High
Fur-bearers	Construction and Operations	Negative	Low to Moderate	Site-Specific to Local	Moderate Term to Permanent	Once to Continuous	Reversible-Irreversible	Low to High resilience	Low to High	Low to High
Ungulates	Construction and Operations	Negative	Low to High	Site-Specific to Local	Long Term to Permanent	Once to Continuous	Reversible	High resilience	Moderate to High	Moderate to High

14.5.1.1.2 Amphibians and Reptiles

Construction

Mitigation measures can reduce or avoid habitat loss – especially along the transmission line and access roads – but loss cannot be avoided within the dam and reservoir.

Characterization of magnitude ranges from moderate for garter snakes, due to a loss of 15% of the potentially suitable hibernation habitat within the LAA too high for western toad due to a loss of 38% of suitable habitat within the LAA. These losses include delineated wetlands, riverine back channels, and wet forests. These changes are characterized as permanent, as they are expected to last for the life of the project and irreversible, as conditions would not be returned to baseline over time or with reclamation. Geographic extent is categorized as local, as changes to amphibian and reptile populations would not extend beyond the LAA. Western toads require long-term ecosystem stability to survive, and portions of the Project activity zone are relatively pristine; for this reason, context has been characterized low for this species. Garter snakes use steep-sided slopes for hibernation, which are prone to periodic slumping. As such, the context for garter snakes is high. The level of species knowledge and certainty associated with habitat loss and species models leads to a confidence level of moderate. The probability ranking of an adverse effect occurring is high.

Operation

Very little potential western toad breeding habitat – 0.2% within the LAA – would be affected during operations of the reservoir; therefore, a residual adverse effect is not considered as likely for this species during this phase.

The magnitude of residual effects on garter snakes during operations is characterized as low, as a less than 10% change in habitat is anticipated during operational maintenance of the transmission line and reservoir operations. Frequency during operations is characterized as continuous, due to habitat alteration and fragmentation due to erosion along the reservoir. These effects are considered reversible, as slopes would stabilize to the extent of current baseline conditions through time. The level of species knowledge and certainty associated with habitat loss and species models leads to a confidence level of moderate. The probability ranking of an adverse effect occurring is high.

14.5.1.1.3 Migratory Birds

Construction

The effects of habitat alteration and fragmentation would differ between species, depending on habitat needs. For the rare songbirds for which habitat suitability mapping was completed the loss of suitable habitat during construction would range between 4.8% (Rusty Blackbird) and 18.7% (Cape May Warbler) of what is available within the LAA. The two rare species that were observed the most – Canada Warbler and Black-throated Green Warbler – would lose 17% and 11.1% of their available habitat, respectively, during construction. The effects to all species would be considerably less during operations.

The characterization of the residual adverse effect for songbirds is reflective of the effects to Canada Warbler and Black-throated Green Warbler. This is a conservative

characterization because the effects of habitat alteration and fragmentation on other songbirds will be less.

The magnitude of the effect is characterized as moderate as four of the six species modeled will lose over 10% of the available suitable habitat within the LAA - including Canada Warbler and Black-throated Green Warbler. The geographic extent for songbirds is characterized as regional, because the Canada Warbler is considered at risk federally, which implies that any effect could have population-level implications outside the LAA. This leads to a characterization of long-term or permanent, as the loss of older valley bottom forest could reduce populations to levels lower than present baseline conditions, and populations may not be fully recoverable. They are considered irreversible, due to the level of loss of habitats that are difficult to replace. Portions of the Project activity zone are relatively pristine; for this reason, context has been characterized as low. A confidence level of low reflects the uncertainty associated with the response of populations of specific songbird species at risk of habitat alteration and fragmentation.

~~The characterization of the residual adverse effect resulting from habitat alteration and fragmentation during construction for migratory birds would differ between species, depending on habitat needs. Characterization of the residual effect of habitat alteration and fragmentation on songbirds is reflective of the effects on Canada Warbler and Black-throated Green Warbler, the two rare species that were observed the most. Of their available habitat in the LAA, 17% and 11% respectively would be lost due to construction, which corresponds to a magnitude characterization of moderate. The geographic extent for songbirds is characterized as regional, because the Canada Warbler is considered at risk federally, which implies that any effect could have population-level implications outside the LAA. This leads to a characterization of long-term or permanent, as the loss of older valley bottom forest could reduce populations to levels lower than present baseline conditions, and populations may not be fully recoverable. They are considered irreversible, due to the level of loss of habitats that are difficult to replace. Portions of the Project activity zone are relatively pristine; for this reason, context has been characterized as low. A confidence level of low reflects the uncertainty associated with the response of populations of specific songbird species at risk of habitat alteration and fragmentation.~~

The characterization of the residual adverse effect for swallows is reflective of the effects on Bank Swallow. Of the swallow species occurring in the LAA, this species is expected to be affected most by habitat alteration and fragmentation, as it nests on banks along the edge of the proposed reservoir. The total number of nests lost is difficult to quantify, but is expected to be more than 20% of what was observed along the banks of the Peace River and is therefore characterized as having a high magnitude. Effects are not expected to extend beyond the LAA and are characterized as local. Duration is characterized as medium term, as the species nests in areas that are prone to continued disturbance, and should re-colonize sites once banks re-stabilize after filling of the reservoir. For these reasons, the effects are characterized as reversible and the environment is considered to have high resilience. A moderate level of confidence reflects the uncertainty in the ability to quantify the number of Bank Swallow nests that would be lost and the ability for the population to find alternative colony sites.

The characterization of the residual adverse effect for waterfowl and shorebirds is high in magnitude, as the Project would remove over 20% of the available river and back

channel habitat, based on the ecosystem mapping (see Volume 2 Section 13 Vegetation and Ecological Communities). Waterfowl and shorebirds are a diverse group that use a wide range of aquatic habitats. Within this group, riverine specialists and species that use the river back channels would be the most affected with the filling of the reservoir. Effects are not expected to extend beyond the LAA and are characterized as local. Duration is characterized as long term, as the effects on nesting habitat are expected to dissipate during the life of the project as vegetation is re-established along the edges of the reservoir and species begin to use placed nest boxes. This is reflected in the characterization of the effects as being reversible. Waterfowl and shorebirds are known to persist when subject to natural or anthropogenic disturbance, and are considered to have high resilience to the effects of habitat alteration and fragmentation, providing there is suitable forage and nesting available.

The characterization of the residual adverse effect for marsh birds is reflective of the effects on Le Conte's Sparrow, Nelson's Sparrow, and Yellow Rail. Effects on American Bittern are not considered based on scarcity of individuals within the LAA. Magnitude is considered high, as the amount of suitable habitat lost during construction would be over 20% for these three species. Effects are not expected to extend beyond the LAA and are characterized as local. Duration ranges from long term to permanent, as the effects of loss of habitat are expected to last for, and possibly beyond, the life of the project, due to the loss of particular wetlands habitats. Marsh birds have specific habitat requirements for breeding – wetlands – and thus, have low resilience to the effects of habitat alteration and fragmentation. A confidence level of moderate reflects the uncertainty associated with the response of marsh birds to habitat alteration and fragmentation.

The characterization of the residual adverse effect for woodpeckers is reflective of the effects on the three species for which habitat suitability mapping was completed: American Three-toed Woodpecker, Pileated Woodpecker, and Yellow-bellied Sapsucker. Magnitude is considered moderate, as the amount of suitable habitat lost

during construction is approximately 12% for these three species. Effects are not expected to extend beyond the LAA and are characterized as local. The characterization of duration as medium term or long term reflects the species' ability to recover from the effect of habitat loss. This process is also reflected in the characterization of the effects as being reversible. Woodpeckers are known to persist when subject to natural disturbance, and are considered to have high resilience to the effects of habitat alteration and fragmentations, providing suitable nesting trees persist. The level of certainty associated with habitat loss and confidence in the species models leads to a confidence level of high. The probability of an adverse effect occurring is high.

Vegetation clearing within the reservoir and along the transmission line would create temporary suitable habitat for Common Nighthawk. Magnitude is considered moderate, as the amount of suitable habitat changed during construction is 16%. Effects are not expected to extend beyond the LAA and are characterized as local. The characterization of duration as moderate term is because suitable habitats are generally not limiting for the species, and the population should readily recover. This process is also reflected in the characterization of the effects as being reversible. Common Nighthawk breed in areas created through both anthropogenic and natural disturbance; they are therefore considered to have high resilience to the effects of habitat alteration and fragmentation. The level of certainty associated with habitat loss and confidence in the species models leads to a confidence level of high. The probability ranking of an adverse effect occurring is high.

Operation

No residual effects are anticipated for ~~waterfowl or~~ marsh birds during operation. Residual effects are expected for songbirds, waterfowl and shorebirds (notably Canada Goose and Common Goldeneye), swallows, woodpecker, and Common Nighthawk. The magnitude of residual effects on migratory birds during operation is characterized as low, as a less than 10% change ~~in habitat~~ is anticipated during operation and maintenance of the transmission line and reservoir. These changes are characterized as site specific, due to their limited extent. They are expected to dissipate during the lifetime of the project and have been characterized as long term. Frequency during operations is characterized as continuous for most species groups, as habitat alteration and fragmentation during operations would occur on a regular basis and at regular intervals with bank erosion. For waterfowl and shorebirds the frequency would be monthly as the extent of winter ice is dependent on winter severity. These effects are considered reversible when slopes stabilize over time. The level of species knowledge and certainty associated with operational activities leads to a confidence level of moderate to high.

14.5.1.1.4 Non-Migratory Game Birds

Construction

The characterization of the residual adverse effect for non-migratory game birds reflects the effects on both Ruffed Grouse and Sharp-tailed Grouse. Magnitude is considered moderate as the amount of suitable habitat lost during construction for Ruffed Grouse and Sharp-tailed Grouse is 15% and 18% respectively. Effects are not expected to extend beyond the LAA and are characterized as local. The characterization of duration as moderate term is based on the expected time frame for local populations to recover. This process is also reflected in the characterization of the effects as being reversible. These species inhabit areas created through both anthropogenic and natural disturbance and, as such, are considered to have high resilience to the effects of habitat

alteration and fragmentation**.** A confidence level of moderate reflects modelling certainty and anticipated effect duration. The probability of an adverse effect occurring is high.

Operations

During operations, the magnitude of the residual effect would decrease to low, as changes of less than 10% of the suitable habitat are anticipated due to transmission line maintenance and operation of the reservoir. Duration would be long term, as the effects would last for the duration of the Project, but would dissipate with time.

14.5.1.1.5 Raptors

Construction

The effects of habitat alteration and fragmentation would differ between raptor species and, with the exception of Bald Eagle habitat, the Project would result in the removal of between 8% (Broad-winged Hawk) and 17% (Northern Saw-whet Owl) of the suitable habitat within the LAA during construction. This change is considered low to moderate in magnitude, depending on the species. Effects of habitat alteration and fragmentation on Bald Eagle are characterized as low, since the provision of alternate nesting platforms would replace lost nests. Geographic extent is categorized as site specific, and duration short term for all but Bald Eagle, Northern Goshawk, and Northern Saw-whet Owl, due to the limited effect on individual tree nests or cultivated fields for ground-nesting species. The local geographic extent and moderate-term duration reflect the potential for habitat alteration and fragmentation to affect Bald Eagle through loss of existing nests, Northern Goshawk through loss of interior old growth forests, and Northern Saw-whet Owl due to requirements for nesting cavities. This is reflective of the length of the duration of construction activities, and the length of time it would take a specific species to recover. For these species, a low resilience to the effects of habitat alteration and fragmentation is assumed, as they require longer-term ecosystem stability to meet their nesting requirements.

A confidence level of low reflects the uncertainty associated with the response of Bald Eagle to habitat alteration and fragmentation. A moderate level of confidence reflects the uncertainty in the response of Northern Goshawk, Great Grey Owl, Great Horned Owl, Boreal Owl, and Northern Saw-whet Owl to loss of nesting habitat. Level of confidence for Northern Harrier, Short-eared Owl, and Broad-winged Hawk is considered high, due to knowledge of local occurrence within the LAA and modelling. Probability of the residual effect ranges from low to high for raptors.

Operation

During operation, the magnitude of the residual effect would decrease to low, as changes of less than 10% of the suitable habitat are anticipated due to transmission line maintenance and operation of the reservoir. Geographic extend is characterized as site specific, as it is dependent on nest locations. Duration is long term, as the effects would last for the life of the Project, but the magnitude would dissipate with time. Frequency is characterized as continuous to reflect the nature of bank erosion along the reservoir. Much of the habitats affected during operations, once stable, would be similar to current baseline conditions; therefore, resilience is considered high.

14.5.1.1.6 Mammals

Effects of habitat alteration and fragmentation on are discussed separately for the four indicator species – bats, beaver, fisher, and ungulates – due to the differences in their habitat requirements and potential for the effects of habitat alteration and fragmentation.

Bats

Construction

With the exception of Portage Mountain, known or expected hibernacula would not be affected by the Project. Characterization of the residual effect for bats is reflective of the loss of roost sites associated with the riparian balsam poplar forests. These losses do not exceed 20% and are categorized as moderate in magnitude. Loss of roosting habitat would have sub-population effects, but would be limited to the LAA and is therefore considered local. Loss of riparian habitat would be permanent and duration has been classified as such. These effects are considered irreversible, as recovery over time would not occur with removal of the Project. The context has been characterized as ranging from high to low, to capture the use of anthropogenic sites by some bat species – little brown/northern myotis – for roosting (high resilience) and requirement for pristine habitats for other species (low resilience).

Operation

Effects of habitat alteration and fragmentation on bats during operations are associated with maintenance operations on the transmission line and bank erosion around the reservoir, both of which are considered site specific. Additional changes in habitat would not exceed 10% and are classified as low in magnitude. They are considered reversible, as the habitat and bat use should recover over time.

Fur-bearers

Effects of habitat alteration and fragmentation are discussed separately for the two indicator species beaver and fisher, due to the differences in their habitat requirements – aquatic versus terrestrial, respectively.

Construction

The characterization of the residual effect for beavers is reflective of reservoir clearing. These effects are considered reversible and are classified as having moderate magnitude, due to the level of habitat alteration. Alteration is considered local because it is based on location of existing lodges in relation to clearing activities. Beavers are expected to re-colonize after disturbance, using portions of the reservoir and compensation areas. Duration has thus been characterized as medium term. Beaver are adapted to habitats subject to frequent natural disturbance, and context is characterized as high. The level of species knowledge and certainty associated with construction activities leads to a confidence level of high.

The characterization of the residual effect for fishers is reflective of effect on denning habitat. Disturbance and displacement of resident fishers is expected to occur within the LAA and is characterized as local. The Project would remove approximately 14% of potential reproductive denning habitat within the LAA, and is characterized as moderate in magnitude. The effect would be greater for females, which have smaller home ranges and have specific requirements for den trees, especially where they overlap the

reservoir. Context is therefore classified as low. Confidence is low, due to the effectiveness of mitigation measures.

Operations

The effects of habitat alteration and fragmentation on fur-bearers during operations are associated with maintenance operations on the transmission line and bank erosion around the reservoir, both of which are considered site specific. Additional changes in habitat are not expected to exceed 10%, and are classified as low in magnitude. They are considered reversible once erosion stabilizes.

Ungulates

No population effects are expected for white-tailed deer.

Numbers of elk are expected to continue to increase in the region, since they are not believed to be limited by habitat. Government management programs are currently attempting to reduce elk numbers. In the absence of mitigation, numbers of moose would be reduced within the LAA, since evidence suggests that they are at a stable long-term population that is related to available habitat. Numbers of mule deer are known to fluctuate dramatically in the Peace Region, primarily in response to winter severity. Their populations are thought to be maintained at high levels due to their use of agricultural lands and winter feed intended for cattle. The loss of suitable habitat may reduce their numbers in some parts of the LAA, but winter severity and access to agricultural lands would continue to have the most influence on total numbers of deer in the LAA. Geographic extent has thus been characterized as local.

The characterizations of the residual effect for ungulates are reflective of the effect on the winter habitats, because losses to other seasonal habitats and birthing habitats are not expected to influence moose, elk, or mule-deer population sizes.

Loss of winter range has been characterized as moderate for moose and elk, and high for mule deer, reflecting the amount of loss. This loss of winter range is considered permanent, as recovery during the life of the Project is not expected. Level of confidence is moderate due to the detailed data collected and subsequent habitat use modelling completed.

Operation

The effects of habitat alteration and fragmentation on ungulates during operations are associated with maintenance operations on the transmission line and bank erosion around the reservoir, both of which are considered site specific. Additional changes in habitat would not exceed 10% and are classified as low in magnitude. They are considered reversible, as use would resume over time.

14.5.1.2 Disturbance and Displacement

The Project can potentially cause disturbance and displacement of wildlife resources by the following mechanisms: i) temporary flooding as a result of the construction headpond, ii) clearing, and iii) human activity. For many criteria, the characterization of residual effects for disturbance and displacement reflects the characterization described above for the aspects of habitat alteration. Further, for most indicators, the disturbance and displacement effects are secondary to effects of habitat alteration and

fragmentation, which represents a longer-term change to habitats and may have population-level effects.

Table 14.20 summarizes the characterization of the residual adverse effect of habitat alteration and fragmentation on all key species groups. An explanation of the characterization is provided by key species group in the text that follows.

Table 14.20 Summary of Characterization of Disturbance and Displacement

		Residual Effect: Disturbance and Displacement								
Key Species Group	**Phase**	**Direction**	**Magnitude**	**Geographic Extent**	**Duration**	**Frequency**	**Reversibility**	**Context**	**Level of Confidence**	**Probability**
Butterflies and Dragonflies	Construction and Operations	Negative	Low	Local	Moderate to Permanent	Continuous to Monthly	Reversible	High resilience	Moderate	Low
Amphibian and Reptiles	Construction and Operations	Negative	Low	Local	Moderate to Permanent	Continuous to Monthly	Reversible	High resilience	Low to Moderate	Low
Migratory Birds	Construction	Negative	Low	Local	Moderate term	Monthly	Reversible	Low and High resilience	Low	High
Non Migratory Birds	Construction and Operations	Negative	Low	Local	Short term to Moderate	Monthly	Reversible	High resilience	Moderate	Low to High
Raptors	Construction	Negative	Low	Site specific	Moderate term	Monthly	Reversible	Low and High resilience	Low to Moderate	Low
Bats	Construction	Negative	Low	Site specific	Moderate term	Monthly	Reversible	Low-resilience	High	Moderate
Fur-bearers	Construction	Negative	Low	Site specific – local	Moderate term	Continuous – monthly	Reversible	Low and High resilience	Low to High	Moderate
Ungulates	Construction	Negative	Low	Local	Moderate term	Monthly	Reversible	High resilience	High	Moderate
Large Carnivores	Construction	Negative	Low	Local	Moderate term	Monthly	Reversible	High resilience	Moderate	Low

14.5.1.2.1 Butterflies and Dragonflies

Disturbance and displacement effects are not expected to differ between construction and operations, and are discussed together. Temporary flooding due to the construction headpond and bank erosion are the mechanisms that would result in disturbance and displacement. Avoidance and reduction is not possible with mitigation, as the timing of events is dependent on natural events and power generation. The Peace River experiences high flows during any year, notably during the spring freshet. Upstream releases from the Peace Canyon Dam also influence daily water levels. The creation of potentially suitable habitats within the reservoir and the creation of additional habitats through compensation may further reduce effects of disturbance and displacement. For these reasons, the magnitude has been characterized as low, as changes are not expected to exceed 10%. Geographic extent is characterized as local because, although temporary flooding due to the construction headpond would occur over large areas, the effects would be restricted to specific sites associated with butterfly and dragonfly activity. Probability is assessed as low, reflecting two uncertainties. The first is uncertainty in the level of use after disturbance. This is directly related to disturbance and displacement, because individuals can only be disturbed or displaced if they are using the area. The second is uncertainty in the extent to which downstream releases – notably between the dam and the Pine River confluence – may displace local populations.

14.5.1.2.2 Amphibians and Reptiles

Disturbance and displacement effects are not expected to differ between construction and operations, and are discussed together. The avoidance and reduction of displacement of amphibians and reptiles due to temporary flooding associated with the construction headpond is not fully possible with mitigation, as the timing of events is dependent on natural events and power generation and on upstream releases from the Peace Canyon Dam. The Peace River experiences high flows during any year, notably during the spring freshet, which results in baseline disturbance and displacement. The creation of potentially suitable habitats along the edge of the reservoir and the creation of additional habitats through compensation may offset any effect. For these reasons, the magnitude has been characterized as low, as changes are not expected to exceed 10%. Geographic extent is characterized as local because, although temporary flooding due to the construction headpond would occur over large areas, the effects would be restricted to specific sites associated with amphibian and reptile activity. Probability is assessed as low, reflecting two uncertainties. First, uncertainty in the level of use after disturbance. This is directly related to disturbance and displacement because individuals can only be disturbed or displaced if they are using the area. Second, the level to which local populations of western toad and garter snake would be displaced by inundation resulting from headpond fluctuation during construction is not known.

14.5.1.2.3 Migratory Birds

The residual effects of disturbance and displacement are not expected to occur during operations, and are not discussed. The avoidance and reduction of displacement of migratory birds due to temporary flooding associated with the construction headpond is not possible with mitigation, as the timing of events is dependent on natural events and power generation. The Peace River experiences high flows during any year, notably

during the spring freshet, which overlaps the migratory bird breeding season. Upstream releases from the Peace Canyon Dam also influence daily water levels in potential reservoir. The frequency of inundation of terrestrial habitats in the construction headpond is anticipated to be greater than baseline. The extent to which this may displace local populations is unknown and is dependent on use once initial clearing occurs. This would differ by species, but ground and shrub nesting species are anticipated to be affected the most. For these reasons, the magnitude has been characterized as low, as changes are not expected to exceed 10%. Geographic extent is characterized as local because, although temporary flooding due to the construction headpond would occur over large areas, the effects would be restricted to specific sites associated with migratory bird nesting, and would be restricted to the breeding season.

Scheduling clearing activities during times of least risk would avoid displacement and disturbance of nesting individuals. If work occurs during critical times, mitigation would reduce effects, but they may not be completely avoidable. Probability is assessed as high because ground-nesting species would nest in disturbed areas that would be affected by temporary flooding due to the construction headpond and construction areas after clearing is complete, and may result in disturbance or displacement.

14.5.1.2.4 Non-Migratory Game Birds

Construction

The avoidance and reduction of displacement of grouse due to temporary flooding associated with the construction headpond is not possible with mitigation, as the timing of events is dependent on natural events and power generation. The Peace River experiences high flows during any year, notably during the spring freshet. Upstream releases from the Peace Canyon Dam also influence daily water levels. The frequency of inundation of terrestrial habitats in the construction headpond is anticipated to be greater than baseline. The extent to which this may displace local populations of Ruffed and Sharp-tailed Grouse is unknown. For these reasons, the magnitude has been characterized as low, as changes are not expected to exceed 10%. Geographic extent is characterized as local because, although temporary flooding due to the construction headpond would occur over large areas, the effects would be restricted to specific sites associated with grouse occurrence. Frequency is characterized as monthly, since grouse are year-round residents of the LAA.

Scheduling clearing activities during times of least risk would avoid displacement and disturbance of nesting individuals. If work occurs during critical times, mitigation would reduce effects, but they may not be completely avoidable. Probability is assessed as high because ground-nesting species would nest in disturbed areas that would be affected by temporary flooding associated with the construction headpond and construction areas after clearing is complete, and could be disturbed or displaced.

Operation

Disturbance and displacement during operations would be associated with maintenance along the transmission line and bank erosion and is characterized as short-term. The magnitude has been characterized as low as changes would be site specific and are not expected to exceed 10%. Geographic extent is characterized as local because disturbance and displacement would be restricted to specific sites associated with grouse locations.

14.5.1.2.5 Raptors

The residual effects of disturbance and displacement are not expected to occur during operations, and are not discussed. The avoidance and reduction of displacement of raptors due to temporary flooding associated with the construction headpond is not possible with mitigation, as the timing of events is dependent on natural events and power generation. The Peace River experiences high flows during any year, notably during the spring freshet, which overlaps the raptor breeding season. Upstream releases from the Peace Canyon Dam also influence daily water levels. The frequency of inundation of terrestrial habitats in the construction headpond is anticipated to be greater than baseline. The extent to which this may displace local populations would differ by species. Ground-nesting raptors – Short-eared Owl and Northern Harrier – are anticipated to be affected more than other species. Few observations of ground-nesting raptors were made during baseline studies within the Project activity zone, suggesting low nesting use. This could change during construction, as clearing large areas of forest within the reservoir would provide suitable breeding habitat for ground-nesting species. Magnitude of disturbance and displacement has been characterized as low, as changes are not expected to exceed 10%. Geographic extent is characterized as site specific because, although temporary flooding associated with the construction headpond would occur over large areas, the effects would be restricted to specific sites associated with raptor nesting in the breeding season, and raptor roosting or hunting in the non-breeding season.

Scheduling clearing activities during times of least risk would avoid displacement and disturbance of nesting individuals. If work occurs during critical times, mitigation would reduce effects, but they may not be completely avoidable. Probability is assessed as low, reflecting uncertainty in the level of raptor use after disturbance. This is directly related to disturbance and displacement, because individuals can only be disturbed or displaced if they are using the area.

14.5.1.2.6 Mammals

Effects on disturbance and displacement of mammals during operation are not anticipated, and are not discussed further.

The avoidance and reduction of displacement of bats due to temporary flooding associated with the construction headpond is not possible with mitigation, as the timing of events is dependent on natural events and power generation. The Peace River experiences high flows during any year, notably during the spring freshet, which overlaps the period when bats are active in the LAA. Upstream releases from the Peace Canyon Dam also influence daily water levels. The frequency of inundation of terrestrial habitats in the construction headpond is anticipated to be greater than baseline. The extent to which this may displace local populations from foraging, roosting, or breeding sites would differ by species. Clearing large areas of forest within the reservoir would result in disturbance and displacement though the change in the availability and suitability of foraging and roosting habitat. Flooding also has the potential to disturb or displace bats from traditional foraging areas. Magnitude of disturbance and displacement has been characterized as low, as changes are not expected to exceed 10%. Geographic extent is characterized as site specific because, although temporary flooding associated with the construction headpond would occur over large areas, the

effects would be restricted to specific sites associated with bat roosting and foraging in cleared areas and along the reservoir.

Scheduling clearing activities during times of least risk would avoid displacement and disturbance of roosting and breeding individuals. If work occurs during critical times, mitigation would reduce effects, but they may not be completely avoidable. Probability is assessed as moderate, because bats are expected to use cleared areas and are known to use edges of the Peace River for foraging.

Fur-bearers

Effects on fur-bearers during operation are not anticipated, and not discussed further. Effects of disturbance and displacement are discussed separately for the two indicator species beaver and fisher, due to the differences in their use of habitat – aquatic versus terrestrial, respectively – and potential to be effected by disturbance and displacement.

The avoidance and reduction of displacement of beaver due to temporary flooding associated with the construction headpond is not possible with mitigation, as the timing of events is dependent on natural events and power generation, and habitats used by beaver would be affected. The Peace River experiences high flows during any year. The frequency of inundation of terrestrial habitats in the construction headpond is anticipated to be greater than baseline. The extent to which this may displace beaver from riverine habitats is not known. Clearing large areas of forest within the reservoir would result in disturbance and displacement though the change in the availability and suitability of beaver food. Magnitude of disturbance and displacement has been characterized as low, as changes, although widespread, are not expected to exceed 10%. Geographic extent is characterized as site specific because the effects of disturbance and displacement would be restricted to specific sites associated with beaver activity in the Project activity zone.

The characterization of the residual effect for fishers is reflective of the timing of clearing within the reservoir. Disturbance and displacement of resident fishers is expected to occur within the LAA. The effect would be greater for females, which have smaller home ranges and have specific requirements for den trees, especially where they overlap the reservoir. The size of the individual home ranges of study animals and the lack of intrasexual exclusion may reduce the risk of displacement due to habitat loss. Magnitude of disturbance and displacement has been characterized as low, as less than 10% of the population in the LAA is expected to be affected. Geographic extent is characterized as local, as the effects of disturbance and displacement on fisher would affect the local population. The low level of confidence reflects the uncertainty in how the fisher population would respond to the effects of disturbance and displacement.

Ungulates

Measurable effects on moose, elk, and mule deer during operation are not anticipated, and not discussed. Project facilities and transportation infrastructure are not expected to have long-term or lasting disturbance or displacement effects on moose, elk, and mule deer over and above the habitat losses previously discussed above. Highways and the reservoir would not form barriers to movement, and disturbances would be mainly confined to the construction period. The extent of disturbance is site specific and dependent on the season and severity of weather conditions. Ungulates may use the newly cleared areas within the reservoir for forage, and could be displaced with temporary flooding associated with the construction headpond. Magnitude of disturbance

and displacement has been characterized as low, as less than 10% of the population is expected to be affected. Geographic extent is characterized as local, as the effects of disturbance and displacement on moose, elk, and mule deer would affect the local population.

Large Carnivores

Measureable effects to grizzly bears and wolves during operation are not anticipated. The potential for effects of disturbance and displacement on grizzly bear is low given the provincial classification of much of the LAA as an area where grizzly bears are extirpated. Wolf numbers and patterns of habitat use in the LAA are primarily dependent on their interactions with local landowners and with hunters. Wolf control is currently occurring through a bounty system and management is designed to reduce the regional wolf population. Magnitude of disturbance and displacement has been characterized as low as few animals are expected to be affected in relation to current baseline conditions.

14.5.1.3 Mortality

The Project can potentially cause direct and indirect mortality to wildlife resources by the following mechanisms: i) when habitats are altered due to flooding, including temporary flooding associated with the construction headpond, ii) from collisions with vehicles and equipment, as well as increased harvest due to increases in roads and human activity, iii) from the release of deleterious substance, iv) when habitat are affected repeatedly (i.e., daily changes in reservoir stage during operations), and v) when predator-prey conditions are altered (i.e., predation of invertebrates when fish are introduction into non-fish-bearing habitat).

For many criterion, the characterization of residual effects for mortality reflects the characterization described above for the aspects of habitat alteration and fragmentation, and disturbance and displacement. Further, for most indicators, the mortality effects are secondary to the effects of these other aspects, because mortality effects represent a one-time loss of individuals in the altered habitat during construction, whereas the other aspects represent a longer-term change to habitats, which may have population-level effects.

Residual effects are not expected for large carnivores during construction or operations. Residual effects of mortality during operations are not expected for migratory birds, non-migratory birds, raptors, bats, fur-bearers, or ungulates, and are not discussed.

Table 14.21 summarizes the characterization of the residual adverse effect of mortality on all key species groups. An explanation of the characterization is provided by key species group in the text that follows.

Table 14.21 Summary of Characterization of Mortality

		Residual Effect: Direct and Indirect Mortality								
Key Species Group	Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Level of Confidence	Probability
Butterflies and Dragonflies	Construction and Operations	Negative	Low to Moderate	Local to Regional	Moderate Term to Permanent	Monthly-Continuous	Reversible	High	Moderate	Low to High
Amphibian and Reptiles	Construction and Operations	Negative	Low to Moderate	Local	Moderate Term to Permanent	Monthly-Continuous	Reversible	High	Moderate	Low to High
Migratory Birds	Construction	Negative	Low	Local	Moderate Term	Monthly	Reversible	High Resilience	Low	High
Non-migratory Birds	Construction	Negative	Low to Moderate	Local	Moderate Term	Monthly	Reversible	High Resilience	Moderate	High
Raptors	Construction	Negative	Low	Site specific	Moderate Term	Monthly	Reversible	High Resilience	Low	Low
Bats	Construction	Negative	Low	Site specific	Moderate Term	Monthly	Reversible	Low Resilience	High	Moderate
Fur-bearers	Construction	Negative	Low	Local	Moderate Term	Continuous	Reversible	Low to High Resilience	Low	Low
Ungulates	Construction	Negative	Low	Site specific	Moderate Term	Continuous	Reversible	High Resilience	High	Low
Large Carnivores	Construction	Negative	Low	Local	Moderate term	Continuous	Reversible	High resilience	Moderate	Low

14.5.1.3.1 Butterflies and Dragonflies

Construction

The magnitude of effects of flooding during construction on butterflies and dragonflies would vary depending on the time of year, with breeding season events having the greatest effects, and are thus characterized as low to moderate. The geographic extent is characterized as regional, because effects on species at risk could have population implications outside the LAA. Frequency is characterized as monthly, due to the expected frequency of occurrence during the spring freshet during the construction period.

Operation

The magnitude of the effect during operation is characterized as low, given low levels of mortality expected due to operational activities. Geographic extent is characterized as local, because effects would be small and restricted to specific sites associated with operational activities or affected by changes in downstream flows.

14.5.1.3.2 Amphibians and Reptiles

Construction

Mortality related to habitat loss cannot be fully avoided for the entire Project, but would be reduced with wetland avoidance, provision of passage structures, and the establishment of no- or restricted-activity buffer zones at some Project components. The potential for mortality associated with flooding during the breeding season, as a result of road traffic and changes to the suitability of wetland habitat from siltation or deleterious substance releases, result in a characterization of moderate. As these effects are associated with construction, duration has been characterized as moderate term. While mitigation measures used to reduce the effects of mortality have proven track records or are industry standards, monitoring of amphibian crossing structures would be required. A confidence level of moderate has been assigned.

Operation

Residual effects on mortality during operation would be associated with maintenance activities along the transmission line, road mortality, and changes in downstream flows. The number of individuals affected is not expected to exceed 10% of the local population and mortality would be limited to the LAA. Magnitude is characterized as low and geographic extent local.

14.5.1.3.3 Migratory Birds

The effects of mortality associated with nest loss due to vegetation clearing and flooding during construction would depend on the time of year. Greater effects would occur when activities overlap the breeding season. Potential effects associated with clearing activities would be reduced because much of clearing is scheduled to occur during the winter months, thereby avoiding conflicts with nesting birds (see Volume 1 Appendix A Vegetation, Clearing, and Debris Management Plan). Scheduling constraints may require clearing activities to occur outside winter months. If clearing occurs during the critical bird breeding season (see Table 14.15), a nest search protocol would be

developed and implemented prior to clearing, to avoid disturbance and possible mortality to nesting birds.

The extent of construction headpond flooding is considered to be a residual effect for ground- and shrub-nesting species. Effects are considered to be of low magnitude – less than 10% change in the population. Geographic extent is characterized as local, to reflect the limit of mortality effects in the LAA. Level of confidence is characterized as low because, similar to displacement and disturbance, the magnitude of the effect is dependent on the level of use of the altered habitat, which is poorly understood.

14.5.1.3.4 Non-Migratory Game Birds

The effects of mortality associated with nest loss due to vegetation clearing and flooding during construction would depend on the time of year. Greater effects would occur when activities overlap the breeding season. Potential effects associated with clearing activities would be reduced because much of clearing is scheduled to occur during the winter months, thereby avoiding conflicts with nesting birds (see Volume 1 Appendix A Vegetation, Clearing, and Debris Management Plan). Scheduling constraints may require clearing activities to occur outside winter months. If clearing occurs during the critical bird breeding season (see Table 14.15), a nest and lek search protocol would be developed and implemented prior to clearing, to avoid disturbance and possible mortality to nesting birds. Magnitude has therefore been characterized as low . The extent of construction headpond flooding is considered to be a residual effect for non-migratory birds, as they nest on the ground. Effects of flooding are characterized as moderate to reflect this increased vulnerability. Geographical extent is local, reflecting the restriction of mortality effects associated with construction to the LAA.

14.5.1.3.5 Raptors

Mortality related to vehicle collisions should not be greater than baseline, as many of the existing roads are used during construction. Potential effects associated with clearing activities would be reduced because much of clearing is scheduled to occur during the winter months, thereby avoiding conflicts with nesting birds (see Volume 1 Appendix A Vegetation, Clearing, and Debris Management Plan). Scheduling constraints may require clearing activities to occur outside winter months. If clearing work during the critical bird breeding season occurs (see Table 14.15), a nest search protocol would be developed and implemented prior to clearing, to avoid disturbance and possible mortality to nesting birds. Magnitude is therefore characterized as low and geographic extent site specific, as it is dependent on the location of nests. The extent of the construction headpond flooding is considered to be a residual effect for ground-nesting raptors, but similar to displacement and disturbance, the magnitude of the effect is dependent on use once vegetation clearing is complete. Effects of flooding are characterized as moderate to reflect this vulnerability. The low level of confidence reflects the poor understanding of the level of altered habitats that would be used by ground-nesting species during construction. Geographical extent is local, reflecting the restriction of mortality effects associated with construction to the LAA.

14.5.1.3.6 Mammals

Bats

Construction

The characterization of the residual effect for bats is reflective of the timing of clearing within the reservoir and quarrying activities at Portage Mountain. Most of the reservoir clearing is scheduled in the winter months, when roosting in trees does not occur. The timing of clearing activities and quarry operations on Portage Mountain would have the biggest risk of mortality for bats, due to the presence of a hibernaculum. Magnitude has been characterized as low, as mortality associated with quarry operations is not expected to result in a greater than 10% change. Geographical extent is local, reflecting the restriction of mortality effects associated with construction in the LAA. The low level of confidence reflects the poor understanding of the level of use of hibernacula at Portage Mountain by bats. Probability is assessed as low, reflecting the uncertainty in the level of mortality to bats that would result due to activities at Portage Mountain.

Fur-bearers

Construction

Consideration for removing beaver from the area prior to clearing and filling is being investigated. This opportunity has not been considered in the effects assessment, due to uncertainty in the ability to implement such a removal. Characterization of the residual effect of mortality is for fishers and is reflective of the timing of clearing within the reservoir.

The magnitude of effects of mortality due to fisher den or resting site loss and general vegetation clearing depends on the time of year, with greater magnitude expected if these activities occur during the spring and summer rearing period. Potential effects associated with clearing activities would be reduced because much of clearing is scheduled to occur during the winter months (see Volume 1 Appendix A Vegetation, Clearing, and Debris Management Plan), when young of the year are mobile; as such, magnitude is characterized as low. Vehicular mortality is expected to occur infrequently, as fishers avoid roads, and is also characterized as low. Geographical extent is local, reflecting the restriction of mortality effects associated with construction in the LAA. The low level of confidence reflects the poor understanding of how fisher would use altered habitats and thus be susceptible to mortality due to Project activities. Probability is assessed as low, reflecting these uncertainties.

Ungulates

Construction

Ungulate mortality from collisions with vehicles is a concern in the Peace Region. Upgraded transportation corridors combined with heavy day and night traffic during construction may lead to higher collision rates in some areas. The magnitude of collision mortality is characterized as low, as less than 10% of any ungulate species would be lost. Geographic extent is characterized as site specific, as collisions would occur at specific locations that are dependent on animal location – which would change with the seasons and associated habitat use by ungulates, and with road conditions, vehicle speed, and presence. Level of confidence is characterized as high, based on the detailed understanding of ungulate mortality patterns in the Peace Region. The low

probability reflects the low number of individuals in the population that are expected to be killed in vehicle collisions during the construction period.

Large Carnivores

Construction

The potential for effects of mortality on grizzly bear is low given the provincial classification of much of the LAA as an area where grizzly bears are extirpated. Wolf numbers and patterns of habitat use in the LAA are primarily dependent on their interactions with local landowners and with hunters. Wolf control is currently occurring through a bounty system and the region has no closed hunting season for wolves at lower elevation. Management is designed to reduce the regional wolf population. Magnitude is characterized as Low as very few animals are expected to be affected in relation to current baseline conditions and there is little change in the regional road density.

14.5.2 Thresholds for Determining Significance

The significance of each residual environmental effect is evaluated, taking into consideration the above criteria and existing knowledge about the VC key indicators. A residual environmental effect of habitat alteration and fragmentation, displacement and disturbance, or mortality would be significant if the effect could threaten extirpation of a key indicator, or result in considerable reductions to habitats or habitat use associated with a key indicator that may in turn further elevate provincial or federal listings and cause the key indicator to be a management concern. This means that a residual adverse effect would be significant:

1. For species that are currently provincially or federally designated as, or considered candidates for, threatened or endangered status (e.g., provincially Red-listed or SARA schedule 1), and the magnitude of the residual effect is characterized as high
2. For species that are currently within a lower listing category (e.g., provincially Blue-listed or SARA Schedule 1 special concern), the magnitude of the residual adverse effect is characterized as high, and the adverse effect may result in the key indicator being elevated to a threatened or endangered status listing

A number of species are listed provincially, but not federally. This could be solely based on the delineation of jurisdictional boundaries, or may be a result of provincial strategies for managing species and ecosystems at risk. So that both provincial and federal decision-makers appreciate the full context of any significance ranking, the determination of significance is provided taking into account both federal and provincial listings.

14.5.3 Determination of Significance of Residual Effects

Habitat alteration and fragmentation is considered the primary effect of the project on wildlife resources because the presence and use of the LAA by wildlife resources is driven by the presence and distribution of habitats. For most indicators, the disturbance and displacement and mortality effects are secondary to the effects of habitat alteration and fragmentation. The available measures to mitigate the potential effects on wildlife resources may not be fully effective. Therefore, the residual effect of the Project of habitat alteration and fragmentation on certain species would be significant because the sustainability of the regional populations of these species would be threatened

(Table 14.22). This includes Yellow Rail (SARA-special concern, Red-listed), Canada Warbler (SARA-threatened, Blue-listed), Cape May Warbler (Red-listed), Bay-breasted Warbler (Red-listed), and Nelson's Sparrow (Red-listed). Of the 4 remaining listed songbirds less than 20% of the available suitable habitat in the LAA for Connecticut Warbler, Black-throated Green Warbler, and Rusty Blackbird would be affected. The Olive-sided Flycatcher is widely but sparsely distributed in forested habitats in Canada. It is listed by COSEWIC as Threatened although the reasons for its population decline are still unclear (COSEWIC 2007). The Project will remove forested habitat that is broadly suitable for Olive-sided Flycatchers, but large amounts of suitable forest interspersed with wetland will remain on the plateau, south of the Peace River. For these reasons these four rare songbirds are not identified as contributing to the determination of significance.

Of the three Red- or Blue-listed species within the waterfowl and shorebird group that have a status of 'possible' or 'confirmed' breeder within the BWBS in the Peace Forest District, two were observed: Surf Scoter and Upland Sandpiper. The residual effect of habitat alteration and fragmentation has been characterized as being high in magnitude for waterfowl and shorebirds due to the loss of river and riparian wetland habitat. Upland Sandpiper is not associated with these habitats for breeding (see Volume 2 Appendix R, Part 4 Section 1.3.1.13); therefore, no change in status is expected due to habitat loss associated with the Project. Surf Scoters were occasionally observed during field surveys and were most often seen during migration (May, and September-October). Two broods of juveniles (8 in each) were noted incidentally during Northern Harrier surveys in July 2010, between Attachie and Bear Flat, confirming breeding on the Peace River. The Surf Scoter has a wide distribution across the province and is not considered to be at-risk nationally. The effects of the Project will not result in a change of status for this species.

Table 14.22 Summary of Assessment of Potential Significant Residual Adverse Effects

Valued Component	Project Phase	Potential Effects	Key Mitigation Measures	Significance Analysis of Residual Effects (Summary Statement)
Wildlife resources	Construction and Operations	Habitat alteration and fragmentation	▪ Minimize project footprint ▪ Establish no- or restricted-activity buffer zones to protect habitat features (wetlands, raptor nests, dens, lodges, leks, mineral licks, etc.) adjacent to construction sites ▪ Maintain a spatial database of wildlife features (wetlands, raptor nests, dens, lodges, leks, mineral licks, etc.) within the LAA ▪ Wetland creation ▪ Maintain surface flow patterns ▪ Follow approved work practices as outlined in Project Environmental Management Plans (See Volume 5 Section 35 Summary of Proposed Environmental Management Plans) ▪ Establish a buffer around riparian areas and water bodies ▪ Manage invasive species within the Project activity zone ▪ Avoid clearing during the breeding season; implement survey protocol if avoidance is not feasible ▪ Revegetate disturbed areas as soon as feasible post-disturbance, using regionally appropriate species ▪ Create artificial snake dens ▪ Erect nesting boxes for cavity-nesting waterfowl in riparian areas and at wetland mitigation sites ▪ Erect alternate platforms for Bald Eagle nesting ▪ Manage select cultivated fields to provide habitat for	Significant

Valued Component	Project Phase	Potential Effects	Key Mitigation Measures	Significance Analysis of Residual Effects (Summary Statement)
			Northern Harrier and Short-eared Owl ▪ Create bat hibernating and roosting sites at Portage Mountain after extraction is complete ▪ Erect bat boxes ▪ Erect fisher den boxes ▪ Create piles of coarse woody debris in disturbed areas ▪ Provide arboreal resting sites for fisher ▪ Manage BC Hydro lands at the Halfway River and Wilder Creek to provide ungulate winter range on the north bank of the Peace River ▪ Explore supplemental feeding of elk and mule deer during severe winter conditions	
Wildlife resources	Construction and Operations	Disturbance and displacement	▪ Avoid clearing during the breeding season; implement survey protocol if avoidance is not feasible ▪ Maintain surface flow patterns during maintenance activities ▪ Manage invasive species along the transmission line and at Project facilities ▪ Revegetate areas disturbed by maintenance activities as soon as feasible post disturbance using regionally appropriate species ▪ Follow approved work practices as outlined in Project Environmental Management Plans (See Volume 5 Section 35 Summary of Proposed Environmental Management Plans) ▪ As feasible, focus lighting on work sites to minimize light pollution in surrounding areas ▪ Restrict access and close temporary roads when no longer needed ▪ Maintain a spatial database of wildlife features (wetlands,	Not significant

Valued Component	Project Phase	Potential Effects	Key Mitigation Measures	Significance Analysis of Residual Effects (Summary Statement)
			raptor nests, dens, lodges, leks, mineral licks, etc.) within the LAA ▪ Establish no- or restricted-activity buffer zones to protect habitat features (wetlands, raptor nests, dens, lodges, leks, mineral licks, etc.) adjacent to construction sites ▪ Retain Bald Eagle nests outside Project activity zones until immediately prior to reservoir filling ▪ Avoid creating bear-human conflicts thorough proper handling of attractants and training of workforce	
Wildlife Resources	Construction and Operations	Mortality	▪ Avoid clearing during the breeding season; implement survey protocol if avoidance is not feasible ▪ Restrict access and close temporary roads when no longer needed ▪ Establish no- or restricted-activity buffer zones to protect habitat features (wetlands, raptor nests, dens, lodges, leks, mineral licks, etc.) adjacent to construction sites ▪ Establish and enforce speed limits on Project roads ▪ Install and maintain amphibian exclusion fencing and crossing structures adjacent to wetlands used by western toad for breeding ▪ Clear reservoir prior to filling ▪ Follow approved work practices as outlined in Project Environmental Plans (See Volume 5 Section 35 Summary of Proposed Environmental Management Plans)	Not significant

14.6 Cumulative Effects Assessment

14.6.1 Screening of Cumulative Effects

With the Project likely to result in residual adverse effects on wildlife resources, the potential cumulative effects of the Project have been assessed. The cumulative effects assessment follows methods explained in Volume 2 Section 10 Effects Assessment Methodology and includes a review of projects and activities, the residual effects of which may interact cumulatively with potential residual effects on wildlife resources as a result of the Project.

14.6.2 Description of Potential Cumulative Effects on VCs

For each project or activity that could cumulatively contribute to habitat alteration and fragmentation, disturbance and displacement, and mortality, an overview of the project or activity, project status, spatial and temporal boundaries, and potential residual effects is provided below, based on the information that is available. To generate the Future Case without the Project, foreseeable future projects and activities are prioritized to assess how they may interact with the Baseline Case. Projects recently constructed or operational (in the last few years) are included in the summary, as their recent status would not be reflected in the habitat mapping that was prepared for the assessment or would yet to be fully incorporated in the provincial and federal governments' current understanding of the status of the key indicators associated with the VC. Many of the projects and activities listed below that occur within the defined RAA are well removed from the LAA for which residual effects of the Project are anticipated. The projects and activities have been included, as they may still remove suitable habitats or affect species that are the same as those affected by the Project.

Figure 14.2 shows the locations of all of the projects and activities occurring in the RAA for which spatial information is available.

14.6.2.1 Projects submitted through Approval Agencies

14.6.2.1.1 Alliance Pipeline Sunrise Meter Station Relocation

The project has been in operation since 2010, and involved the relocation of an existing meter station to a new 50 m by 50 m site closer to Huron Energy's Sunrise Compressor Station (TERA Environmental Consultants Ltd. 2010c), approximately 27 km northwest of Dawson Creek. The relocated meter station was constructed to accommodate the receipt of natural gas originating in the Sunrise producing area of northeastern B.C. The goal was to minimize natural gas liquids dropping out from the rich incoming natural gas stream before reaching the desired location.

Connecticut warbler was the only listed animal species found within 5 km of the site. No wildlife species with conservation status, or potential habitat for wildlife species at risk, or species of special status were identified at the Project site (SHARP Environmental Ltd. 2010).

As outlined in the Environmental Assessment report (TERA Environmental Consultants Ltd. 2010c), potential residual environmental effects include:

- Loss or alteration of potential wildlife habitat

- Displacement of wildlife away from Project area
- Potential increase in wildlife mortality due to vehicle/wildlife collisions

~~A cumulative effect is not expected~~ The National Energy Board Environmental Screening Report (National Energy Board 2010) concludes that "… the potential adverse environmental effects can be resolved through the use of standard design or routine mitigation measures as outlined in Alliance's application and its Manual. Therefore, the NEB is of the view that the potential adverse environmental effects of the Project are not likely to be significant." Although this statement may be considered ambiguous as the persistence of potential residual effects, given the size of the project (within a 50 m by 75 m fenced yard and approximately 50 m of buried piping), and the application of standard design and routine mitigation measures, residual effects are not anticipated. Therefore a cumulative effect is not anticipated.

14.6.2.1.2 Groundbirch East Receipt Meter Station

The project has been in operation since 2011 by NOVA Gas Transmission Ltd. It involves the construction and operation of a new meter station approximately 45 km west of Dawson Creek to provide an interconnect between Westcoast Energy Inc.'s pipeline system – downstream of the Sunset Creek compressor station – and Groundbirch Mainline (National Energy Board 2012).

Potential residual environmental effects from this project identified were (National Energy Board 2012):

- Loss or alteration of wildlife habitat for wildlife species at risk
- Increase in vehicular collisions on access roads and at the project site
- Sensory disturbance and potential displacement of wildlife away from the meter station site during construction and cleanup activities
- A spill, fire, or rupture that may potentially adversely affect wildlife habitat

Species at risk that may be affected include Common Nighthawk, Barn Swallow, and Short-eared Owl, all of which are species at risk that would be affected by the Project. Effects from the Groundbirch East Receipt Meter Station may combine with those of the Project and result in a cumulative effect.

14.6.2.1.3 Groundbirch Mainline

NOVA Gas Transmission Ltd. operates a 24 km pipeline, of which 5 km parallels existing rights-of-way and roads; the remaining 19 km was newly cut (TERA Environmental Consultants Ltd. 2010a). A construction right-of-way of 39 m was required for the project, with 20 m being a permanent right-of-way and 19 m being temporary workspace. The pipeline is located 40 km northwest of Dawson Creek and 33 km southwest of Fort St. John. Construction of the project was completed in 2012.

The potential residual environmental effects on wildlife and wildlife habitat associated with the construction and operation of the project were (TERA Environmental Consultants Ltd. 2010c):

- Alteration of habitat
- Displacement of wildlife from the project area and temporary changes to movement patterns

- Increase in mortality or injury rates due to collisions and spills
- Loss of potential habitat for species at risk

~~A cumulative effect is not expected.~~Rare species and suitable habitats may be affected, and potential residual effects may combine with those of the Project and result in a cumulative effect.

14.6.2.1.4 Moberly River Pipeline Replacement

Westcoast Energy Inc. replaced a section of the Fort Nelson natural gas mainline, with work finished in 2011. A 14 m long section of pipe became exposed due to southward migration of the Moberly River along an outside bend at the pipeline crossing location. The exposed section of pipe was replaced, and a new 50 m x 600 m right-of-way was created adjacent to the northwest edge of the existing right-of-way, as well as additional workspace to accommodate all of the equipment and machines used on the project.

No Environmental Assessment for this project could be located, but effects are expected to be similar to other pipeline projects. Rare species and suitable habitats may be affected, and potential residual effects may combine with those of the Project and result in a cumulative effect.

14.6.2.1.5 Provident Beatton River Replacement Project

This project involved the replacement of portions of the approximately 53 km long Taylor to Boundary Lake Pipeline, which carries sweet high vapour pressure hydrocarbon products from the city of Taylor to Boundary Lake, Alberta. A 36 km long section of the pipeline required replacement to ensure safe and reliable operation. The majority of the replacement work occurred within the existing right-of-way under operations and maintenance activities; however, a new right-of-way (approximately 16 km long) was required for the construction of a more suitable crossing of the Beatton River (National Energy Board 2011).

No residual effects could be located within available reports. Possible effects on wildlife identified include alteration of habitat, disturbance of migratory bird nests and nestlings, displacement of wildlife, habituation of wildlife to construction waste, and wildlife conflicts/mortality (National Energy Board 2011).

From the National Energy Board report (2011), six Sharp-tailed grouse leks were found in close proximity to the project. The nearest lek was 210 m from the proposed right-of-way and all other leks were located 500 m away or greater. The project fell within ungulate winter range and important migratory waterfowl habitat. Common Nighthawk, Canada Warbler, Olive-sided Flycatcher and western toad are all Schedule 1 wildlife that occurs in the project area; however, no species or sign was observed along the proposed route during the 2010 survey. Short-eared Owls (Schedule 2-listed species) have potential habitat within the proposed pipeline vicinity. Effects on species at risk listed above, all of which would be affected by the Project, may combine with those of the Project and result in a cumulative effect.

14.6.2.1.6 Septimus Pipeline Project

This project has been in operation since 2010 and involved the construction of 21 km of rich gas pipeline between the Septimus Gas Plant and Alliance Pipeline. The route was within B.C.'s Agricultural Land Reserve and primarily traverses private cultivated

agricultural land and some forested land. The start of the pipeline is located approximately 16 km directly south of Fort St. John.

~~No Environmental Assessment for this project could be located, but effects are expected to be similar to other projects (for example, altered habitat, changes to wildlife movement, potential increase in wildlife mortality and disturbance of undiscovered habitat). A cumulative effect is not expected.~~

No Environmental Assessment for this project could be located, but effects are expected to be similar to other pipeline projects. Rare species and suitable habitats may be affected, and potential residual effects may combine with those of the Project and result in a cumulative effect.

14.6.2.1.7 Dawson Creek Processing Plant

The project involves the construction and operation of a raw natural gas processing facility 16 km west of Dawson Creek, and consists of a natural gas processing plant and the associated access road, approximately 1 km of gas pipeline, a liquid handing loop, and the acquisition of a segment of the Spectra Energy Midstream Bissette Pipeline. The processing capacity of the Dawson Plant is to be installed in two phases. The initial phase is complete and has been in operations since 2011. The second phase of this project, which includes the installation of additional processing equipment, has a planned in-service date of February 1, 2013.

Possible effects on wildlife include (TERA Environmental Consultants Ltd. 2010b):

- Alteration or loss of habitat
- Displacement of wildlife away from project area
- Potential for vehicular collision-related mortality
- Combined effects on the western toad, which include an incremental increase in mortality as a result of habitat loss during construction/maintenance activities that require vegetation/ground disturbance

Effects to western toad may combine with those of the Project and result in a cumulative effect.

14.6.2.1.8 Transmission North 2011 Expansion Project

The project provides incremental firm service from the outlet of the Fort Nelson Processing Plant to a new point of interconnection between the Transmission North system and NOVA Gas Transmission Ltd.'s Groundbirch Pipeline. The project was made up of two primary components in different locations. The first component involved the installation of a new compressor unit, upgrades at existing stations, and the construction of approximately 24 km of pipeline (Fort Nelson Mainline). The second component involved the construction of a new pipeline and associated facilities, construction of approximately 20 km of pipeline (Stewart Lake Pipeline), and construction of a new compressor station. The project was operational in 2011.

Residual effects on wildlife identified (Stantec Consulting Ltd. 2010) include:

- Loss of preferred habitat, including breeding and foraging
- Risk of mortality to wildlife

- Noise disturbance that can cause alterations in wildlife movement: sensory disturbance, habitat avoidance
- Displacement of wildlife, changes in species composition, and modification of predator/prey interactions

~~A cumulative effect is not expected.~~Effects to species at risk included habitat loss to rare warblers (including Canada Warbler) and western toad. Effects on these species at risk may combine with those of the Project and result in a cumulative effect.

14.6.2.1.9 Dokie Wind Project

Preliminary modelled layout comprises 200 turbines of 1.5 MW each. Phase 1 of the project (144 MW) has been operational since 2011. Phase 2 would include the construction of the remaining towers to produce 156 MW.

The residual effects identified for wildlife include altered habitat availability, disruption of movement patterns, and mortality risks (Hélimax et al. 2006).

Effects to species at risk, particularly bats, may combine with those of the Project and result in a cumulative effect.

14.6.2.1.10 Farrell Creek 88-I South Gas Plant Project

Talisman Energy Inc. is proposing to construct and operate a natural gas processing plant 25 km north of Hudson's Hope (Stantec Consulting Ltd. 2012). The proposed plant, which will be adjacent to its existing Farrell Creek Central Production Facility (88-I Plant), will remove water and natural gas liquids from the raw gas to meet the pipeline requirements. The project is to be developed in two or more stages, and will eventually build to a processing capacity of approximately 14 million m^3/day.

No detailed analysis of effects is available as this project, as it is still in the application phase. Possible effects on wildlife from this project include loss of habitat areas, disturbance of migratory bird nests, sensory (auditory or visual) disturbance, and direct or indirect mortality (Stantec Consulting Ltd 2012).

Effects to species at risk may combine with those of the Project and result in a cumulative effect.

14.6.2.1.11 Wolverine Secure Landfill Project

Tervita Corporation, formerly CCS Landfills Services, is proposing to develop a secure landfill approximately 48 km northwest of Dawson Creek (CCS Corporation 2011). The proposed location is on Crown land, and will accommodate industrial activities in northeastern British Columbia. The project is currently in the Environmental Assessment stage, with the goal of an Environmental Assessment Certificate to be issued in March 2013.

Residual effects have not yet been identified in available reports. Possible effects on wildlife include habitat loss, fragmentation and effectiveness, sensory disturbance, potential contaminant exposure, and vehicle encounters (CCS Corporation 2011).

Effects may combine with those of the Project and result in a cumulative effect.

14.6.2.1.12 Dawson Creek/Chetwynd Area Transmission Project

BC Hydro is planning to build a new substation (19 km east of Chetwynd), approximately 60 km of overhead transmission line from Sundance Substation to Bear Mountain Terminal, expansion of existing substations, 12 km of transmission line from Bear Mountain Terminal to Dawson Creek substation, and a passive reflector near Chetwynd substation for communication purposes (BC Hydro 2011).

Key residual effects on wildlife include direct and indirect changes to wildlife habitat – such as loss, alteration and fragmentation – and habitat avoidance due to sensory disturbance (BC Hydro 2011). In addition, increased access to wildlife habitat will increase the potential to have higher rates of wildlife mortality through hunting and defence of persons and/or property (BC Hydro 2011). Effects to species at risk may combine with those of the Project and result in a cumulative effect.

14.6.2.1.13 Transmission North 2012 Expansion Project

This proposed pipeline is designed to provide incremental firm service from receipt points along Westcoast's Fort Nelson Mainline and the NOVA Gas Transmission Ltd. Groundbirch Pipeline (TERA Environmental Consultants Ltd. 2011). The proposed 24 km route parallels the existing Fort Nelson Mainline pipeline right-of-way for most of its length, with the exception of small localized diversions at Mackie and Lynx creeks, to optimize the watercourse crossings. In addition to the construction right-of-way, temporary workspace will also be required at crossings, sidebends, and log decks, and where grading is necessary.

Possible residual effects on wildlife and wildlife habitat include (TERA Environmental Consultants Ltd. 2011):

- Habitat alteration – including forested areas, watercourses, and drainages
- Habitat loss or alteration due to spills or fire from gas release
- Displacement due to sensory disturbance – displacement of wildlife away from right-of-way during construction – and site-specific maintenance activities may result in use of potentially suboptimal habitat
- Changes to movement patterns – barriers associated with construction, windrows, trenches
- Mortality – vehicular collisions, increased predation, spills or fires

The project may have residual effects on alteration of potential habitat for wildlife species at risk (TERA Environmental Consultants Ltd. 2011). Effects to species at risk may combine with those of the Project and result in a cumulative effect.

14.6.2.1.14 Gething Coal Mine Project

The project involves Canadian Dehua International Mines Group Inc. constructing a new underground coal mine and on-site coal preparation plant approximately 25 km west of Hudson's Hope (Rescan Environmental Services Ltd. 2006).

This project is currently in the Environmental Assessment stage, with the estimated construction startup in 2013. Current status of proposal is unknown, and no specific residual effects are available for review. Effects to species at risk may combine with those of the Project and result in a cumulative effect.

14.6.2.1.15 Carbon Creek Coal Mine

This project involves the development of an open-pit surface and underground metallurgical coal mine. The mine will be designed to achieve a production rate of 2.9 million tonnes of clean coal per year, with an estimated mine life of 30 years (Rescan Environmental Services Ltd. 2012). Currently the project is in the Environmental Assessment stage, with construction of project tentatively planned to begin in 2014 and surface mine coal production beginning in same year.

The Project Description is available but no residual effects on wildlife resources have yet been identified. Potential direct and indirect effects of the project on wildlife include habitat loss and alteration, road mortality, disturbance, increased hunter access, and

possible attractants (garbage, lights, etc.). Effects to species at risk may combine with those of the Project and result in a cumulative effect.

14.6.2.1.16 Hackney Hills Wind Project

The proposed wind power project is located west of Fort St. John and directly northwest of Hudson's Hope near the top of the W.A.C. Bennett Dam (Aeolis Wind Power Corporation 2008). The wind farm will have an estimated generation capacity of up to 1,000 MW, with the intent to sell electricity to BC Hydro. The wind farm falls on Crown land and is surrounded by all-season petroleum developments and forestry service roads. This project is currently in the Environmental Assessment stage.

Residual effects have not yet been identified. Possible effects on wildlife include habitat loss and alteration, disturbance to wildlife, and possible effects on wildlife habitat features (Aeolis Wind Power Corporation 2008).

Effects specific to bird populations include direct mortality associated with the operation of the turbines, operation of vehicles, site clearing, and the physical presence of overhead transmission lines, as well as sensory disturbance primarily associated with construction activities and noise generated from the turbines (Aeolis Wind Power Corporation 2008).

Effects specific to bats include exposure to, and potential disturbance by, project-related stimuli such as noise and light, and increased mortality risk from collisions with turbine blades, and to a lesser extent, collisions with other project features (power lines) (Aeolis Wind Power Corporation 2008). These, and effects on other species at risk may combine with those of the Project and result in a cumulative effect.

14.6.2.1.17 Wartenbe Wind Energy Project

The project site is located in the south of the Peace River region of B.C. on Mount Wartenbe, southeast of Chetwynd. The project originally received its environmental Assessment Certificate in 2006, but subsequently changed ownership. An application to extend the deadline of the certificate was submitted in 2011, as construction had not commenced and the certificate was set to expire. In 2012, the name of the holder of the Environmental Assessment Certificate was again changed. The preliminary modelled layout includes 47 turbines of 1.5 MW each (AXYS Environmental Consulting Ltd 2006).

Residual effects identified include effects on movement patterns, mortality risk, and habitat availability. Effects on species at risk may combine with those of the Project and result in a cumulative effect.

14.6.2.1.18 Wildmare Wind Energy Project

This project involves Finavera's construction of a 74 MW wind park, connector roads and electrical connections, access roads, substation and operations centre, and an overhead transmission line (Finavera Wind Energy Inc. 2011). It will be located 5 km west of Chetwynd. The project is currently under review.

Residual effects on wildlife include (Finavera Wind Energy Inc. 2011):

- Habitat loss and fragmentation
- Disruption of movement corridors

- Water quality degradation
- Auditory and sensory disturbance – noise
- Attractants
- Predation and hunting risk
- Mortality – roads, collisions

Finavera noted (2011) that there is likely to be cumulative adverse effects on bats, migrating raptors, nocturnal migrating birds, and breeding birds in the area – within 100 km – over the next 25 years from collisions with turbine blades. Effects to bat, raptor, breeding, and migratory bird species at risk may combine with those of the Project and result in a cumulative effect.

14.6.2.1.19 General Oil and Gas Activities

There are many oil and gas related activities found throughout the northeast portion of the province; collectively, there are a number of environmental effects that result from the exploratory stage, as well as from the drilling and development stage. As new extraction technologies become available, additional sites will be more attractive for exploration and development. The timing and level of development will likely be set by market prices, but recent plans for liquefied natural gas should continue interests in the region's gas sector.

During exploration, activities that take place that may have adverse effects on wildlife resources include drilling exploration, construction of access roads, and seismic exploration.

In the drilling/development phase, larger areas are required that involve the construction of well pads, access roads, pipelines, and other ancillary facilities, as well as the drilling of wells. Habitat loss would be the largest effect, although effects associated with fragmentation, disturbance and displacement, and mortality of wildlife species would also occur.

According to information available, a total of 32 oil and gas facilities are approved or under review within the RAA. Facilities are point features that indicate any grouping of equipment where water, hydrocarbon liquids, or natural gas are processed, measured, upgraded, or stored (Ministry of Labour – Citizens' Services and Open Government 2012).

A total of 344 pipeline projects (from 2004 to present) are approved within the RAA, with another 23 under review. Linear length of pipeline was estimated from available spatial information and totals 377 km within the RAA.

Petroleum Access Roads are applications for roads over any Crown land. A total of 1,422 approved or proposed access road applications are within the RAA, with a total length of 823 km. In addition, there are 37 approved or proposed Petroleum Development Road applications, totalling 163 km within the RAA. Petroleum Development Roads applications are for construction or to existing non-status tenured roads over any Crown land and/or use of non-status, unencumbered existing access roads on Crown land.

Effects may combine with those of the Project and result in a cumulative effect.

14.6.2.1.20 General Forestry Activities

A more detailed review of the forestry activities is provided in Volume 3 Section 21 Forestry. Information provided in that section has been summarized below.

The RAA for wildlife resources overlaps portions of the Fort St. John and Dawson Creek Timber Supply Areas, as well as Tree Farm Licence 48. The current Timber Harvesting Land Base for all three areas combined is 2,152,127 ha. Of this total area, the Annual Allowable Cut is presently set at 4,875,000 m^3 of both coniferous and deciduous forest. The government will be reviewing the amount cut and possibly setting new limits for both Timber Supply Areas in the near future, and in 2017 for Tree Farm Licence 48.

Timber harvesting replaces mature forest with early seral stage plant communities. Roads are considered a leading cause of habitat fragmentation, affecting wildlife and wildlife habitat. Roads can also contribute to erosion and sedimentation of aquatic and terrestrial habitats, and act as vectors for the persistence and spread of invasive plants. Loss of older successful forests or larger, intact tracks of forested lands can reduce the habitat availability for a variety of species, particularly Red- and Blue-listed species that rely on characteristics found primarily in older stands (for example, species that use cavities) or within interior forest conditions. Effects may combine with those of the Project and result in a cumulative effect.

14.6.2.2 Land Tenures

Over 11,000 ha have been identified within recent land tenure applications within the RAA (Table 14.23). Commercial recreation tenure applications account for the largest percentage of land use. Activities associated with commercial recreation include camps – for hunting and fishing – trail riding, cat skiing, heli-hiking, and guided nature viewing. These activities typically have considerably less disturbance compared to other industrial activities, but habitat loss and alteration for wildlife resources as well as disturbance and displacement of individuals and possible increases in hunting and poaching of select species will occur. Effects may combine with those of the Project and result in a cumulative effect.

Table 14.23 Total Number of Land Tenure Applications Within the RAA

Tenure Purpose	Number of Applications	Total Area (ha)
Agriculture	22	1,631
Commercial	1	<1
Commercial recreation	17	9,411
Communication	3	1
Community	2	5
Energy production	8	9
Industrial	35	98
Institutional	1	<1
Quarrying	18	293
Residential	3	1
Utility	24	43
Total	**134**	**11,492**

14.6.2.3 Parks and Protected Areas

The Peace River Boudreau Lake proposed protected area comprises a portion of the south bank of the Peace River valley, Boudreau Lake, the lower Moberly River valley, and the islands near the confluences of the Moberly River and Maurice Creek with the Peace River. The proposed protected area is 23,789.6~~6,750~~ ha in size and partially overlaps BC Hydro's flood reserve for the Project (Hillcrest Geographics 2012~~Dawson Creek LRMP Inter-Agency Planning Team 1999~~). The protected area has not been officially established.

The protected area would be a positive effect and represents habitats for a number of rare wildlife species.

14.6.3 Cumulative Effects Mitigation Measures

The projects summarized above will result in the alteration and fragmentation of habitats, displacement and disturbance of wildlife, and possible wildlife mortality.

It should be noted that BC Hydro is not the lone organization contributing to the decline in wildlife resources, as many of the other projects or industries mentioned above also contribute to the overall decline. Recovery efforts could be undertaken at the regional level collaboratively with other projects. BC Hydro has limited authority to guide regional initiatives to support the diversity and persistence of wildlife resources. This would be better guided by the provincial government.

14.6.4 Characterization of Residual Cumulative Effects

Past land use has shaped much of the region's current wildlife habitat abundance and distribution. Habitats for a variety of species at risk are currently under threat of loss and extirpation due to land development (Baseline Case). Some of the species listings are simply a result of the geographic distribution and provincial boundaries, which restrict occurrences to a small portion of the province. In other instances, populations or habitats are simply unique and rare on the landscape.

In the future, many of the same activities associated with the baseline case will continue (e.g., forestry, oil, and gas development) and residual effects are expected, regardless of the Project proceeding (Future Case without the Project). Most of these activities are removed from the Peace River valley, affecting areas of adjacent plateau and mountainous sites within the RAA. Some are within the LAA – notably, forestry, oil, and gas, and some land tenure applications.

The majority of the Project disturbance is within the Peace River valley, affecting riparian habitats that are generally removed from most other developments (Project Case). Other Project components situated in upland areas removed from the Peace River (e.g., transmission line and some quarry sites) may overlap with future projects and activities – especially with forestry, and oil and gas development. As such, the Project is likely to result in a residual cumulative effect of habitat alteration and fragmentation, disturbance and displacement, and mortality for songbird species at risk, non-migratory birds, raptors, bats, and fisher. The characterization of the effect is listed below (Table 14.24).

Table 14.24 Characterization of Residual Cumulative Effect – Habitat Alteration and Fragmentation

Effects Criteria	Project Case
Direction	Negative
Magnitude	High
Geographic Extent	Regional
Duration	Permanent
Frequency	Continuous
Reversibility	Irreversible
Context	Low and High resilience
Level of Confidence	High
Probability	High

14.6.5 Determination of Significance of Residual Cumulative Effects

The Project is likely to result in a significant adverse effect in the alteration and fragmentation of habitat for some key indicators (see Section 14.5). Consequently, the cumulative effect of the Project on habitat for those species is also significant. The anticipated residual effects of habitat alteration and fragmentation to wildlife resources from all other future projects and activities combined are also considered significant, even if the Project is not constructed. This occurs because effects associated with other projects and activities that involve road construction, forestry, land clearing, etc. are not fully mitigable, and the future loss of suitable habitats for species at risk is expected to further elevate provincial or federal listings.

14.7 Monitoring and Follow-Up

In accordance with the EIS Guidelines, follow-up programs would be required to verify the accuracy of the effects assessment, and to determine the effectiveness of the measures implemented to mitigate the adverse effects of the Project on wildlife resources.

A Wildlife Resources Follow-Up Plan would be implemented to address key uncertainties about the accuracy of the effects assessment and effectiveness of mitigation. The plan would include provisions to address the following residual effects characterizations identified in the effects assessment as having low confidence:

- Habitat alteration and fragmentation during construction for songbirds, waterfowl, shorebirds, Bald Eagles, bats, and fishers
- Disturbance and displacement during construction for migratory birds and ground-nesting raptors
- Disturbance and displacement during operations for western toad and garter snakes
- Mortality during construction for migratory birds, Northern Harrier, Short-eared Owl, and fishers

Habitat alteration and fragmentation during construction is expected to have a moderate magnitude effect on songbirds, reducing populations to levels lower than baseline

conditions. This effect is characterized with a low confidence because of the variation in response by different songbird species, including how individual species' populations would respond to the loss of habitats.

The effect of habitat alteration and fragmentation during construction to waterfowl and shorebirds is characterized as a high magnitude, due to the amount of river and back channel habitat lost. The duration and geographic extent of the effect is dependent on expected use of the reservoir and wetlands created through habitat compensation. There is low confidence in the characterization of this expected use, because it largely depends on the success of vegetation establishment along the boundaries of the reservoir, the use of nest boxes, and the extent of ice formation.

A large number of Bald Eagle nests would be removed during construction. Mitigation would replace the number of available nest platforms at a 2-to-1 ratio for active nests lost. The magnitude of this effect is characterized as low, but is dependent on the success of the mitigation, and thus is characterized with a low confidence.

The effect of habitat alteration and fragmentation to bats during construction is characterized as a moderate magnitude, because over 11% of the total habitat available would be lost. The prediction of higher suitability habitat is subject to limitations, and the distribution and abundance data are incomplete for bat species in B.C. These uncertainties have led to a characterization of the effect prediction as having a low confidence.

Habitat alteration and fragmentation during construction would have a moderate magnitude effect on fishers, including a permanent loss of den sites. Mitigation measures can replace some den trees in areas adjacent to the reservoir, but the success of artificially created den trees or structures is not known. To account for this uncertainty, the effects characterization has been identified with a low confidence.

The effect of disturbance and displacement to migratory birds and ground-nesting raptors during construction is characterized as a low magnitude, with ground-nesting birds anticipated to be affected the most, although the majority of the clearing and filling of the reservoir is currently planned for the winter months, outside the nesting season. There is a low confidence in these characterizations, however, because magnitude is dependent on the scale of the activity and time of year that it occurs. In addition, some birds may be displaced more readily by activities that disturb them, while others would be more tolerant. It is also difficult to determine the extent to which ground-nesting birds would use the newly cleared areas in the reservoir.

The surface water regime downstream of the reservoir would be affected by dam operations. The effects of these changes to hydrology are expected to disturb and displace western toads and garter snakes in this area, particularly between the dam and the Pine River confluence (the first major influx of water downstream of the dam). The magnitude of this effect is characterized as low, but there is low confidence in the characterization because the reaction of these species to the anticipated changes in hydrology is difficult to determine.

Mortality of migratory birds, Northern Harrier and Short-eared Owl during construction was characterized as a low magnitude, but with a low confidence. The effects of nest loss due to vegetation clearing and flooding during construction could have greater effects, depending on the time of year and extent of use in areas seasonally inundated. Hydrology modelling provides an understanding of the extent of the flooding, but the

extent of use of the newly cleared areas in the reservoir by ground- and shrub-nesting species immediately prior to flooding is difficult to determine.

The effect of fisher den or resting site loss due to vegetation clearing during construction was characterized as having a low magnitude. But this could have greater effects depending on the time of year (i.e., rearing period). In addition, the effectiveness of mitigation is unknown, so the residual effect characterization has a low confidence.

To address these uncertainties, the follow-up plan should include the following:

- Targeted mitigation monitoring
- Directed studies to address specific uncertainties

Targeted mitigation monitoring should include:

- Monitoring Bald Eagle nesting populations adjacent to the reservoir, including use of artificial nest structures
- Monitoring of waterfowl and shorebird use in natural wetlands, created wetlands, and artificial wetland features
- Monitoring the effectiveness of artificial den creation for fishers
- Monitoring the effectiveness of toad migration crossing structures installed along project roads

Directed studies should include:

- Surveys of songbird populations and ground-nesting raptors during construction and operations
- Surveys of western toad and garter snake distribution downstream of the dam

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