

August 10, 2017

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**Re: Basic Impact Analysis for the TransCanada Highway (TCH) Snowshed Drainage Improvement Project – Glacier National Park**

Dear Mr. Lussier:

Barr Engineering and Environmental Science Canada Ltd. (Barr) is pleased to submit the attached Basic Impact Analysis (BIA) report for the TransCanada Highway Snowshed Drainage Improvement Project – Glacier National Park.

If you have questions or would like more information, please contact our project manager, Paul Fraser (403-592-8321, [pfraser@barr.com](mailto:pfraser@barr.com)), or me (952-832-2629, [rhardegger@barr.com](mailto:rhardegger@barr.com)).

Sincerely,

A handwritten signature in black ink, appearing to read "Richard Hardegger".

Richard Hardegger, P.Eng.  
Vice President/ Principal in Charge

A handwritten signature in black ink, appearing to read "Paul Fraser".

Paul Fraser, P.Biol.  
Senior Ecologist/Project Manager



# **TransCanada Highway (TCH) Snowshed Drainage Improvement Project – Glacier National Park**

Prepared for  
Parks Canada Agency

August 2017

# TransCanada Highway (TCH) Snowshed Drainage Improvement Project – Glacier National Park

August 2017

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## Acronyms

<b>Acronym</b>	<b>Description</b>
AOA	Archaeological Overview Assessment
Barr	Barr Engineering and Environmental Science Canada Ltd
BC	British Columbia
BC CDC	BC Conservation Data Centre
BIA	Basic Impact Analysis
BMPs	<i>Parks Canada National Best Management Practices for Roadway, Highway, Parkway and Related Infrastructure</i>
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPR	Canadian Pacific Railway
CSP	Corrugated Steel Pipe
DFO	Fisheries and Oceans Canada
EPP	Environmental Protection Plan
ESC	Erosion and Sediment Control
ESO	Environmental Surveillance Officer
ESSF	Engelmann Spruce-Subalpine Fir
FU	Field Unit
GNP	Glacier National Park
IAC	Impact Assessment Coordinator
ICH	Interior Cedar-Hemlock
IUCN	International Union for Conservation of Nature
MBCA	<i>Migratory Birds Convention Act</i>
MRG	Mount Revelstoke Glacier
MSDS	Material Safety Data Sheets
PCA	Parks Canada Agency
QAES	Qualified Aquatic Environmental Specialist
QEP	Qualified Environmental Professional
RAP	Restricted Activity Permit
RCMP	Royal Canadian Mounted Police
SARA	<i>Species at Risk Act</i>
SAR	Species at Risk
SRP	Spill Response Plan
TCH	Trans-Canada Highway
VC	Valued Component
VEMCs	Vegetation Elements of Management Concern
VOCs	Volatile Organic Compounds
WVCs	Wildlife-Vehicle Collisions

## 1.0 Project Title and Location

TransCanada Highway (TCH) Snowshed Drainage Improvement Project – Glacier National Park (GNP)

The proposed Project area is in Glacier National Park (GNP) at five snowsheds along the TCH (KM 0 at East Gate):

- Tupper Timber at KM 17.0
- Tupper 2 at KM 17.5
- Tupper 1 at KM 18.2
- Lens at KM 18.8
- Single Bench at KM 19.7

## 2.0 Proponent Information

### **Parks Canada Agency (PCA)**

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### **Basic Impact Analysis (BIA) Author**

Barr Engineering and Environmental Science Canada Ltd.

(Internal Filing #: 61011161.00)

## 3.0 Proposed Project Dates

Planned commencement: 2017-09-01

Planned completion: 2017-11-01

## 4.0 Internal Project File #

Federal Infrastructure Improvements: 566-02

Field Unit: MRG2016-24

## 5.0 Project Description

The snowsheds are an integral part of the Rogers Pass avalanche defense, protecting users of the TCH. Therefore, the continued functionality of the snowsheds is vital to the operation of the highway. PCA has identified that current drainage and leakage into the snowsheds has an adverse effect on driving conditions through the snowsheds. The leakage causes water to pool in the snowshed which then freezes during cooler weather, creating icy driving conditions. In addition, the existing leakage may increase the rate of degradation of the snowshed structures through the freeze-thaw cycle. In order to reduce and minimize leakage in the snowsheds, it is imperative that the drainage infrastructure located around the structures handle the volume of water flowing to the snowsheds. As identified in the snowshed Investigation Drainage and Leakage Study (RJC, 2005), a key to reducing leakage into the snowsheds will be to provide upgrades to the snowsheds' upslope drainage infrastructure. Upgrades to the drainage infrastructure allows water to flow around the snowsheds thus reducing the volume of water reaching the leakage points. The project description was originally submitted to the Mount Revelstoke Glacier (MRG) field unit (FU) in September 2016 (**Appendix 1**). Updates and greater project detail are described in this section.

### 5.1 Project Objective

The snowsheds along the TCH through GNP are a vital component of the network for road user safety. This Project will rehabilitate the original drainage components of the five (5) snowsheds in GNP as well as install new drainage features to facilitate the movement of water in and around the structures. The specific objectives will be to:

- construct access roads to the top of each snowshed (except for Tupper 1 and Single Bench) for construction and future maintenance;
- create ditches along the upslope side of the structures;
- place impermeable ditch lining in new ditches;
- place impermeable liner on the roof of Tupper 1 and Tupper 2; and
- cleanout roadside ditches and culvert inlet/outlets within and adjacent to the snowsheds.

There will also be minor excavations and placement of riprap along the road shoulders to localize water runoff and prevent erosion. To maintain roadside drainage, culverts will be placed in roadside ditches at the new access roads.

### 5.2 Project Rationale

The TCH is a vital component of the transportation network that serves millions of visitors in the Mountain Parks each year. It is also vital to the commercial transport of goods. Improvement of upslope ditches and roadway drainage ditches, controlling seepage from the snowsheds roof and retaining walls will reduce icing inside the sheds minimizing the risk to public safety while improving condition of the assets.



### *Project Location*

The proposed Project location is along TCH, GNP snowsheds, Rogers Pass (KM 0.0 is GNP East Gate). Construction work is targeted for Tupper Timber snowshed at KM 17.0, Tupper No.2 snowshed at KM 17.5, Tupper No.1 snowshed at KM 18.2, Lens snowshed at KM 18.8 and Single Bench snowshed at KM 19.7. The elevation range for this project spans from approximately 1130 m to 1270 m above sea level.

### *Footprint Size*

Anticipated size of disturbance footprint for construction at each of the snowshed structures is 6,000 m<sup>2</sup> for Tupper Timber, 23,000 m<sup>2</sup> for Tupper No.2, 7,700 m<sup>2</sup> for Tupper No.1, 7,000 m<sup>2</sup> for Lens and 820 m<sup>2</sup> for Single Bench.

### *Offsite Locations*

There are no offsite locations anticipated for this Project. Contractor staging and laydown areas will be within the existing pullouts and gun positions adjacent to the snowshed locations and ditching excavation placement sites, as determined by the MRG FU.

The combined footprint of the proposed staging and laydown areas adjacent to the snowsheds is approximately 1,500 m<sup>2</sup> while the ditching excavation placement sites footprint will be determined based on MRG FU proposed sites.

## **5.3 Project Phases and Activities**

### *Site preparation/access activities*

Site preparation activities include mobilization to site, vegetation clearing and grubbing for access road construction and ditch excavation, setup of temporary site office/laydown yard, and survey/staking of work.

### *Dimensions of structures, size of excavation, area of disturbance, fill requirements*

Dimensions of structures, construction, and disturbance are shown in the attached **Appendix 2**. The size of disturbance footprint for construction (access roads, ditching, etc.) is as follows:

Tupper Timber: It is anticipated that an estimated 5,930 m<sup>2</sup> area will be disturbed at this location. An access road will be constructed on the upslope of the snowshed between KM 17.09 and KM 17.16. Road base aggregates, from outside of the Park, will be required for construction of the access road. A 14.2 m long, 600 mm diameter corrugated steel pipe (CSP) culvert will be installed under the new access road, parallel to the TCH, to maintain roadside drainage. Clearing and grubbing of vegetation will be required on top of the snowshed, as well as for the new access road.

Tupper No.2: Estimated area of disturbance at this location is about 20,954 m<sup>2</sup>. An access road will be constructed on the upslope of the snowshed between KM 17.85 and KM 17.90. Road base aggregates, from outside of the Park, will be required for construction of the access road. An 11.5 m long, 600 mm

CSP culvert will be installed under the new access road, parallel to the TCH, to maintain roadside drainage. Lock-block steps with natural fill material will be installed on the south side of the snowshed where practically possible. Clearing and grubbing of vegetation will be required on top of the snowshed, as well as for the new access road.

Tupper No.1: An estimated total of 9,885 m<sup>2</sup> area will be disturbed at this location. The existing access road will be cleared of vegetation and used for construction. Clearing and grubbing of vegetation will be required on top of the snowshed. Lock-block steps with natural fill material will be installed on the south side of the snowshed.

Lens: An estimated 5,870 m<sup>2</sup> will be disturbed at this location. An access road will be constructed on the upslope of the snowshed stretching from KM 18.70 to KM 19.05. Road base aggregates, from outside of the Park, will be required for construction of the access road. An 18.5m long, 600 mm CSP culvert will be installed under the new access road approach, parallel to the TCH, to maintain roadside drainage. Clearing and grubbing of vegetation will be required for the new access road as well as along the upslope of the snowshed for ditch construction and future maintenance access requirements.

Single Bench: Anticipated area of disturbance at this location will be about 820 m<sup>2</sup>. Lock-block steps with natural fill material will be installed on the south side of the snowshed. Existing ditches will be re-established to provide positive drainage to culvert inlets. No vegetation clearing is anticipated.

### *Construction activities, methods, materials, equipment to be used*

Conventional excavation, grading, clearing and grubbing, as well as stripping for construction of the access roads. Equipment to be used may consist of excavators, loaders, compaction equipment, dump trucks, water trucks, dozer and chainsaws for hand clearing.

### *Associated project work*

Traffic control, clearing, grubbing, stripping, excavation, placing excavation material and imported fill for backfill, install culverts, placing topsoil, install roof and ditch liners, installing lock-block steps with natural fill material, placing riprap and grouting in place.

### *Changes to utilities and addition of new lines*

There will be no changes to utilities, capacity or demand and no new lines (i.e. water, electric, natural gas, and wastewater) are to be added for this Project.

### *Toxic or hazardous materials*

The only toxic or hazardous materials expected for the Project activities are fuels (diesel and gasoline) and solvents for construction vehicles and equipment, and concrete grout for rip rap placement.

### Operational requirements

After completion of the Project, maintenance will be required by the Highways Operations Unit. Maintenance will consist of checking ditches and cleaning out avalanche and/or roadside debris as required. To be detailed further upon completion of the design.

### Site modifications, structure removals, site reclamation activities

Modifications to existing sites will include new access roads, new ditches, culverts (for access roads), and placement of riprap. Access roads will remain in place after construction to facilitate maintenance of the rehabilitated assets.

### Plans & drawings attached

Construction drawings are attached in **Appendix 2**.

## 5.4 Scope of Construction

**Table 5-1** below describes the proposed work areas along the TCH assessed in this BIA. These Project details were identified using the most up-to-date knowledge, however, based on future construction, environmental, and archeological surveys, the Project details in columns 2 through 5 of the table are subject to change. A mapbook of the Project area is provided in **Appendix 3**.

Table 5-1: Proposed work areas along Trans-Canada Highway, Glacier National Park

Snowshed Location	Start (km)*	End (km)*	Length (m)	Est. Footprint (ha)
Tupper Timber	16+810	17+160	350	0.593
Tupper 2	17+230	17+900	670	2.095
Tupper 1	18+000	18+600	600	0.989
Lens	18+700	19+050	350	0.587
Single Bench	19+600	19+900	300	0.082

*\*Measured from the eastern border of GNP along the TCH*

Materials excavated from ditching will be stored at locations proposed by MRG FU. The footprint of these sites will be determined at such time.

## 5.5 Preparation/Construction Phase

Preliminary designs are presented in **Appendix 2**. To construct this design, the following aspects will be required:

- Mobilization/demobilization of manpower, equipment (that includes, but is not limited to: excavators, loaders, compaction equipment, dump trucks, water trucks, dozer and chainsaws for hand clearing), materials (culverts, aggregates, geotextiles), and other resources.
- Survey and staking of work and demarcation of the Project clearing limits.
- Set-up and operation of traffic signage and traffic control.
- Set-up and operation of lay-down and storage areas and temporary site office. In coordination with MRG FU, suitable locations adjacent to the snowsheds will be used for staging and materials storage purposes.
- Vegetation clearing, stripping, grubbing and grading of:
  - the existing upslope embankment in preparation for the construction of access roads and drainage ditches; and
  - applicable snowshed roofs to facilitate placement of geotextile liners.
- Sourcing construction materials:
  - Gravels will come from outside the Park;
  - Riprap and other construction material supplies will come from outside the Park; and
  - Road base material and other reinforcement materials will come from outside the Park.
- Earthwork:
  - Ditch excavations:
    - excavation for construction of new drainage ditches;
    - rehabilitation of the existing drainage ditches; and
    - hauling / stockpiling material from the Park.
  - Construction of access roads:
    - excavation to design subgrade for construction of access roads;
    - placing road base aggregates for access roads and compacting / grading;
    - placing gravel access road surface; and
    - placing road-edge topsoil.
  - Cutting slopes:
    - will be initially cut to a uniform design slope;
    - will mostly use bulldozers, tracked excavators and on/off-road haulers; and
    - will be reworked to produce an undulating profile and rounded cut perimeter to achieve a more natural and visually pleasing appearance followed by hydroseeding.

- Compaction of embankments/road base materials by excavators, vibration compaction equipment and water truck.
- Structural/construction works:
  - Off-site fabrication and delivery of impermeable ditch and roof liners from locations outside the Park;
  - Installation of ditch and roof liners, including anchors / pins to secure in place;
  - Culvert installation and repair of roof drains, cleaning of culvert inlets / outlets, installation of roof and ditch liners; and
  - Placement of aggregates for backfill and placing riprap and grout.
- Reclamation:
  - Disturbed areas, identified for rehabilitation, will be decompacted and made rough (hand loose) to facilitate reseeding; and
  - Disturbed areas will be reseeded as soon as construction work is completed with an MRG FU approved seed mix.
- Waste Disposal:
  - Garbage and waste materials (including fuels and solvents) will be placed in appropriate disposal containers;
  - Construction waste will be removed from the National Parks as directed by the Departmental Representative;
  - Opportunities to recycle waste materials (e.g. concrete, steel, wood forms) will be investigated; and
  - Merchantable timber will be salvaged and residual material will be hauled off-site unless burning or other removal mechanisms are approved by the MRG FU.

## 5.6 Operation and Maintenance Phase

On completion of the Project, PCA will operate and maintain the highway in essentially the same manner as is currently done. Maintenance will include checking ditches and cleaning out avalanche and/or roadside debris as required. No additional maintenance activities beyond the status quo are anticipated.

## 5.7 Decommissioning Phase

No decommissioning activities are anticipated for this Project.

## 5.8 Summary of Project Phases and Activities

For the construction/operation aspects above, the activities in **Table 5-2** will be necessary.

Table 5-2: Summary of Project in Relation to Project Phases and Activities

Phases		Associated Activities	Project Specifics
Project Components	Construction / Site Preparation	Supply and storage of materials	Construction materials will be stockpiled within the existing pullouts and gun positions adjacent to the snowshed locations. Construction material supply will come from outside the Park.
		Clearing	Vegetation clearing from snowshed roofs, ditches and embankments and for construction of access roads.
		Disposal of waste	Construction waste will be removed from the Park as directed by the Departmental Representative.
		Drainage	Cleanout of drainage ditches and culverts within the snowsheds and ditch re-grading. Excavation and placement of riprap along the road shoulders to localize water runoff and prevent erosion.
		Excavation	Roadway embankments excavation for construction of access roads; re-establishment of existing ditches; excavation of sumps for sediment trapping.
		Grading	Roadway embankments for stabilization, grading of access road aggregates.
		Use of machinery	Typical road construction equipment that includes but is not limited to excavators, loaders, dump trucks, water trucks, dozer, and chainsaws for hand clearing.
		Transport of materials/ equipment	Transport of construction materials to site (aggregates, riprap, grout, geotextiles, liners and construction equipment) and removal of construction wastes.
		Use of Chemicals	Fuel, oil and solvents for construction equipment and vehicles.
		Set up of temporary facilities	Construction management facilities (trailer) in the existing pullouts and gun positions adjacent to the snowsheds.
		Traffic control	Traffic controllers and signs will be present on the roadway during construction activities.
		Waste disposal	Construction, trade, hazardous waste and domestic waste materials to be removed from the Park.
		Use/Removal of temporary facilities	Temporary site office to be removed during demobilization by Contractor.
	Operation	Use of Chemicals	Fuel for equipment performing maintenance activities.
		Access	Cleared and constructed access roads provide public access to the top of the snowsheds where insufficient barriers exist.

## 5.9 Project Timing

Design is scheduled to be completed in early 2017. Construction is tentatively scheduled to begin in early September 2017 and be completed in late fall 2017.

## 5.10 Additional Details

*Potential for the Project to affect use of lands or resources by aboriginal persons (as relevant):*

None

*Other jurisdictions or departments involved in project development, review & approval:*

Park Canada Agency Cultural Resource Management

## 6.0 Valued Components Likely to be Affected

Using the Effects Identification Matrix (**Appendix 4**), the following potential interactions between the Project and the surrounding environment were identified. **Table 6-1** summarizes the rationale for carrying Valued Components (VCs) forward into the effects analysis. The subsequent sections explore deeper into the characteristics of each VC that make them susceptible to project interaction.

**Table 6-1: VCs and rationale for analysis**

Valued Components	Rationale for Analysis
Air Quality and Noise	Combustion engine vehicles will be used for construction activities which may change ambient air quality and noise levels
Soil and Landforms	Project design includes landform and slope adjustments for access roads and drainage contouring
Water	The project area has surface water and drainage features: <ul style="list-style-type: none"> <li>• potential adverse impacts to on-site and downgradient surface water</li> <li>• no groundwater resources in Project area</li> </ul>
Fish and Fish Habitat	This project involves drainage features: <ul style="list-style-type: none"> <li>• Regulatory requirements; potential to cause serious harm to fish as defined under the federal <i>Fisheries Act</i></li> <li>• Potential effects on fish populations if deleterious substances are released into watercourses during drainage works</li> </ul>
Flora	This project involves vegetation clearing: <ul style="list-style-type: none"> <li>• Potential impact on rare plants and native vegetation</li> <li>• Potential for introduction or spread of invasive species</li> </ul>
Fauna	The Project area is used by multiple species of fauna for habitat and migration: <ul style="list-style-type: none"> <li>• Potential impacts to <i>Species At Risk Act</i> (SARA) listed species</li> <li>• Potential impacts to migratory birds in contravention of <i>Migratory Birds Convention Act</i> (MBCA)</li> <li>• Potential positive impacts to wildlife mortality (vehicle strikes) as project design includes lock-block steps and temporary fencing during the snow-free period</li> </ul>
Cultural Resources	This project is located in Rogers Pass National Historic Site, therefore a potential exists to impact both known and yet-to-be discovered archaeological resources
Visitor Experience and Safety	The Project area is a well-used corridor for visitors to access features of GNP and a high-use corridor for commercial transport. The project may have the following effects on visitor experience and safety: <ul style="list-style-type: none"> <li>• Noise disturbance during construction</li> <li>• Traffic delays during construction</li> <li>• Positive impact on public safety during the operation phase with improved road conditions in and around the snowshed</li> </ul>

### 6.1 Air Quality and Noise

Ambient air quality is generally high throughout GNP. However, construction activities involve the use of combustion engines, dust-generating machines, and the removal of purifying/noise-buffering vegetation.



As such, air quality and dust/noise levels may be adversely affected through the preparation, construction and operation Project phases. Due to the Project activities having a potential interaction with this VC, it will be carried forward into the effects analysis.

## 6.2 Soil and Landforms

The TCH in the Project area passes through the Interior Cedar-Hemlock (ICH) Ecoregion. It is located at an approximate elevation of about 1200 m within the Nordic (NC5) and Lauretta (LR1) ecosites that are comprised of non-calcareous, medium to coarse textured colluvial material (Achuff et al. 1984). Brunisols and Podzols are the two major soil types in this area. Adjustments to existing slopes are expected while building access roads and creating drainage ditches above the snowsheds. Due to the Project activities having a potential interaction with this VC, it has been carried forward into the effects analysis.

## 6.3 Water

### 6.3.1 Surface Water

The Knowledge Management organization of the BC Ministry of Environment developed a stream centerline network from the 1:50,000 scale Canadian Topographic Map (Province of BC, 2014). The main surface water body identified in the vicinity of the Project area is Connaught Creek (00000CLRH-169977), which runs adjacent to the entire length of the Project area at a distance of 40-110m downgradient of the TCH (**Figure 6-1**). Several unnamed creeks drain the avalanche pathways above the snowsheds, and are primarily conveyed around the snowsheds by collection ditches and culverts, as observed during a field reconnaissance visit on July 1-3, 2017. Drainage specific to each snowshed is as follows:

- No stream centrelines exist at Tupper Timber snowshed as confirmed by field reconnaissance. A culvert parallels the TCH under/behind the north snowshed wall. An ephemeral creek drains spring meltwater into the roadside ditch at the eastern end of the snowshed.
- Tupper 2 snowshed has one unnamed (00000CLRH-169979) stream centreline crossing near KM 17.76, however field reconnaissance found this stream intercepted by a drainage ditch running to a culvert near KM 17.54; the culvert at this location flows at a 45° downward to the east, connecting to a lower culvert that parallels the TCH under/behind the north snowshed wall. Two additional unnamed creeks streams were identified at Tupper 2:
  - The westernmost (KM 17.6) flows to the same culvert KM 17.54. A second culvert at this point drains overflow across the top of the snowshed to the south side of the TCH.
  - The easternmost (KM 17.36) flows along a second drainage ditch to the eastern end of the snowshed where it cascades into the roadside ditch. A culvert at this location drains flow across the TCH.
- No stream centrelines exist at Tupper 1 snowshed. However, field reconnaissance found three unnamed creeks draining the avalanche pathway: two near KM 18.31 and one near KM 18.15. The latter is conveyed via ditch to the eastern end of the snowshed, where it drains through a culvert to the roadside ditch. The former two drain via a 45° downward culvert to the east, connecting to

a lower culvert that parallels the TCH under/behind the north snowshed wall. No water crosses the TCH at this snowshed.

- Lens snowshed has a single unnamed (00000CLRH-169980) stream centreline which crosses the TCH near KM 18.75. Field reconnaissance and aerial photos show this stream has been diverted via channelized debris flow to the west, and through a culvert under the TCH near KM 19.25. The former channel is now dry, along with another dry stream near KM 18.74. A culvert parallels the TCH under/behind the north snowshed wall.
- Single Bench snowshed has a single unnamed (00000CLRH-169982) stream centreline near KM 19.72. Field reconnaissance confirmed this stream, which is captured in a large basin above the snowshed, and drained via culvert near KM 19.75. A culvert parallels the TCH under/behind the north snowshed wall.

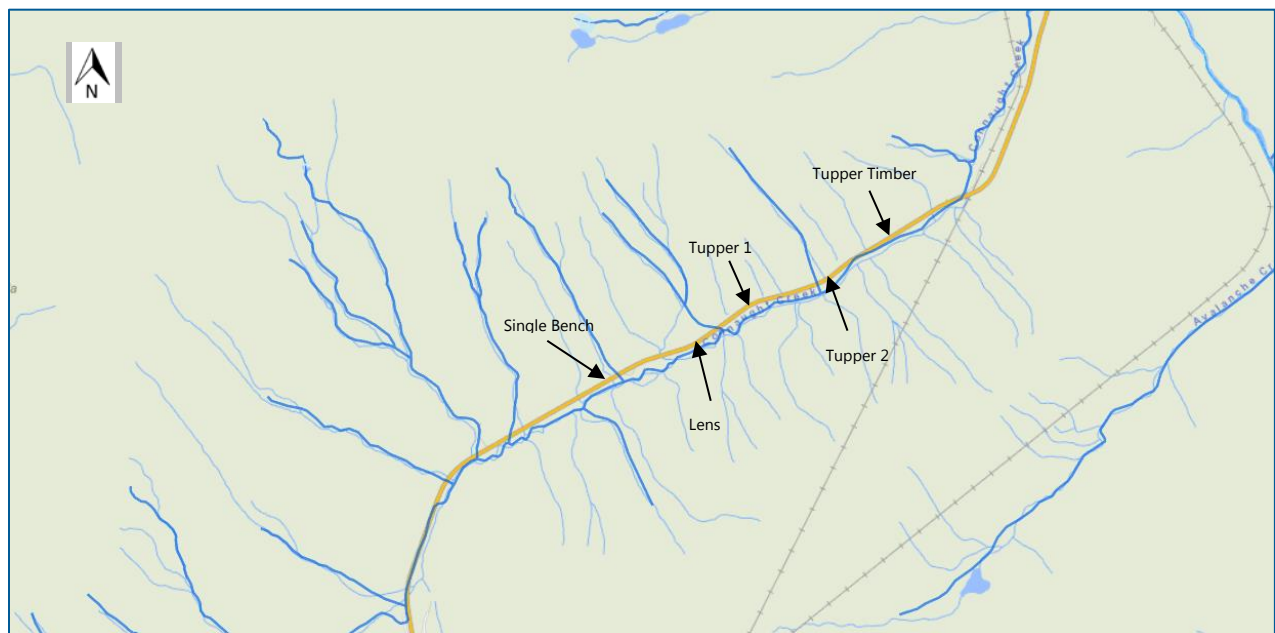


Figure 6-1: Stream centrelines from the 1:50,000 topographic map (Province of BC, 2014), mapped on (BC, 2016)

Due to a Project design involving alteration of existing drainage ditches, the creation of new drainage ditches, and the potential to change the flow, drainage, and erosive characteristics of the snowsheds, and channels that feed the Connaught Creek, this VC has been carried forward into the effects analysis.

### 6.3.2 Groundwater

Groundwater wells are commonly used to source potable water along the TCH. However, according to the BC Water Resources Atlas (BC, 2016), no water wells were identified within the Project area. Since there is no anticipated Project interaction with this VC, it has not been carried forward into the effects analysis.

## 6.4 Fish and Fish Habitats

No field surveys for fish or fish habitat have been conducted by Barr Engineering and Environmental Science Canada Ltd. (Barr) to date. Therefore, the following data sources were consulted and/or queried for fish species known to occur within GNP:

- Parks Canada Biotics Web Explorer (Parks Canada, 2013) queried for regularly occurring species listed under SARA Schedule 1 and/or identified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) within the GNP;
- BC Conservation Data Centre (BC CDC) Conservation Data Centre Mapping Service (BC CDC, 2008a);
- BC Ministry of Environment Species Ecosystems Explorer (BC CDC, 2017);
- BC CDC Habitat Wizard, (BC CDC, 2008b);
- BC CDC iMAPBC, (BC CDC, 2013); and
- Fish Inventory Data Base Queries (Government of BC, 2015)

The proposed Project area roughly parallels Connaught Creek from KM17.0 through KM 20.0. The creek is known to be fish bearing at this stretch. Although not located within the Project area, all surface water from the project area directly drains into the creek. A list of potential fish species in the Connaught Creek, compiled from the above resources, is shown in **Table 6-2**. This list was further augmented by discussions with Aquatic Specialists from MRG FU on October 17, 2016 (Taylor et al., 2016) and review of PCA's historical stocking records from 1959 – 2012 for MRG (Parks Canada, 2015a).

**Table 6-2: Potential fish species in water bodies in the Connaught Creek**

Common Name	Scientific Name	<sup>1</sup> PCA-Identified Locations (if available)	Potential for occurrence within Connaught Creek
Cutthroat trout <sup>2</sup>	<i>Oncorhynchus clarkii</i>	Casualty creek; Mouth of Beaver River; Flat Creek; Marion Lake; Schuss Lake	Nil – No historic observations in the area
Bull trout (Pacific) pop. 11	<i>Salvelinus confluentus</i>	Connaught Creek; Beaver River; Cougar Creek; Grizzly Creek; Illecillewaet back waters; Loop Brook; Mountain Creek; Unnamed tributary feeding into Beaver River at km12.5; Asulkan Creek; Tangiers; Woolsey-Mouth; Avalanche Creek; Bostock Creek; Flat Creek; East gate Creek	High – Observations in Connaught Creek which runs adjacent to the Project area
Westslope cutthroat trout - BC population <sup>3,4</sup>	<i>Oncorhynchus clarkii lewisi</i> pop. 8	Schuss Lake	Nil – No historic observations in the area

<sup>1</sup>Known locations as identified by PCA (1959 - 2012) (Parks Canada, 2015a)

<sup>2</sup>Listed as Blue Status in BC (BC Conservation Data Centre, 2017)

<sup>3</sup>SARA Schedule 1 species (Government of Canada, 2016)

<sup>4</sup>Identified by COSEWIC (Government of Canada, 2017a)

### SARA Listed Species:

**Cutthroat trout** spawn between March and early July. Spawning usually occurs in gravel stream riffles where the female digs a nest in the gravel. They also feed in these areas (and downstream from), typically on zooplankton, insects, fishes, and crustaceans. The **westslope** subspecies of cutthroat trout - BC population 8 (*Oncorhynchus clarki lewisi*) - is the only fish species in GNP that is listed by SARA under Schedule 1 as Special Concern, and identified by COSEWIC as a Special Concern species. However, there are no historical observations of this subspecies within the Project area.

### Other Species

The **bull trout** (*Salvelinus confluentus*), population 11 is not listed under SARA or identified by COSEWIC in BC. Bull trout spawn in the fall, typically from mid-August to late October (DFO, 2017). Egg development and hatch are temperature dependent, with hatch times 50-126 days. Survival to hatching is much reduced at water temperatures >26.5°C. Alevin emerge near the beginning of June (McPhail 2007).

Project activities are not expected to directly alter fish habitat. The steep gradient immediately downstream of the Project area is a barrier to upstream movement of fish from Connaught Creek into the Project area. However, activities involving excavation and grading of drainage ditches have the potential to release sediment and deleterious substances into fish bearing habitat in Connaught Creek. Due to the Project activities having a potential interaction with this VC, it will be carried forward into the effects analysis.

## 6.5 Flora

Glacier National Park is within three Ecoregions (ICH, Engelmann Spruce-Subalpine Fir (ESSF) and Alpine). The proposed Project area is in the ICH Ecoregion within the NC5 and LR1 ecosites dominated by western hemlock (*Tsuga heterophylla*) and western red cedar (*Thuja plicata*) (Achuff et al., 1984, Achuff and Dudynsky, 1984). Other typical vegetation species include: western yew (*Taxus brevifolia*), oak fern (*Gymnocarpium dryopteris*), devil's club (*Oplopanax horridus*) and Douglas fir (*Pseudotsuga menziesii*) (Achuff et al., 1984). The Project activities described above, specifically vegetation clearing for new disturbances such as access road construction will result in the permanent loss of vegetation communities. This VC will therefore be carried forward into the effects analysis.

### SARA Listed Species:

A query of the Parks Canada Biotics Web Explorer (PCA, 2013) and the BC CDC Species Ecosystems Explorer (BC CDC, 2017) sought to identify federally-listed vegetation elements of management concern (VEMCs). All results are shown in **Appendix 5**.

The only SARA-listed species found was **whitebark pine**, which has Endangered SARA status, and is identified the same by COSEWIC. Provincially, it is considered "blue-list," (species of special concern). It is typically found in cold, windy, high elevation west-south rocky outcrops and as a result, many stands are geographically isolated. It is a stress-tolerant pine and its hardiness allows it to grow where other conifer species cannot (USFWS, 2014).

Whitebark pine is ecologically very significant in maintaining snow pack and regulating runoff, initiating succession after fire or other disturbance events (e.g. avalanches), and providing seeds that are a high-energy food source for many species of wildlife (USFWS, 2014). The elevational limits for this species vary from 1000m to 2250m (COSEWIC, 2010). Though infrequent, whitebark pine is not uncommon in GNP.

Early flowering rare plant surveys by Barr in July 2017 did not identify occurrence of whitebark pine within the Project area. Late flowering rare plant surveys are planned for mid August 2017 which will also include whitebark pine searches. The results of these surveys along with associated mitigation requirements will be presented in an Addendum to this BIA prior to vegetation clearing. A Research and Collection Permit is required from MRG FU to perform the rare plant survey.

### Other Species

An early flowering rare plant survey by Barr in July 2017 did not identify rare plants within the Project area. Studies conducted in Beaver Valley may be indicative of the rare plants in the Project area (BC CDC, 2008b). One provincial "red-list" (extirpated, endangered, or threatened species) and five "blue-list" rare plants were found (**Table 6-3**). Even though not listed by SARA or COSEWIC, provincially listed species found can be indicative of ecosystem health and destruction of individuals is highly discouraged. It is important to note that majority of these rare plants were observed in habitats and elevations similar to those found in the Project area (i.e., on avalanche pathways, and on pond edges). Further descriptions of these species are provided below.

**Table 6-3: Provincially listed plant species of management concern in GNP**

Common Name	Scientific Name	BC List Status <sup>1</sup>	Habitat Type	Location of Study
Blunt-sepaed starwort	<i>Stellaria obtuse</i>	Blue	Area is steep, actively eroding and the site is unstable; there are also quite a few invasive species. Found very wet waterfall spray zone, in calcareous silt.	Bear Falls
Dainty moonwort	<i>Botrychium crenulatum</i>	Blue	Antique forest, in shaded Red Cedar litter beneath Devil's Club	Beaver Valley Trail and Gravel Pit Area
Crested wood fern	<i>Dryopteris cristata</i>	Blue	Area is steep, actively eroding and the site is unstable; there are also quite a few invasive species. Found very wet waterfall spray zone, in calcareous silt.	Bear Falls
Mountain moonwort	<i>Botrychium montanum</i>	Red	Montane antique cedar forest. South of a series of inactive gravel pits, vulnerable to disruption if gravel is mined	Beaver Valley Trail and Gravel Pit Area
Elliptic spike-rush	<i>Eleocharis elliptica</i>	Blue	Riparian areas of lakes and streams, as well as wet meadows in the steppe and montane zones	Rogers Pass Historic Site, First fen SE of TCH Bridge over the Beaver River

Common Name	Scientific Name	BC List Status <sup>1</sup>	Habitat Type	Location of Study
Western St. John's-wort	<i>Hypericum scouleri ssp nortoniae</i>	Blue	Moist/wet riparian areas of wetlands and waterbodies, as well as open slopes	Rogers Pass Historic Site, Avalanche Alley

<sup>1</sup>Red - Extirpated, endangered, or threatened species, blue - special concern species (BC CDC, 2017)

The above list of rare plant species known to occur near the Project area was supplemented with the results of epiphytic lichen flora studies of northwest North America by Björk et al. (unpublished data), and studies by PCA between 2002 and 2008 for VEMCs in Mount Revelstoke National Park and GNP (**Appendix 6**).

**Blunt-sepaed starwort** is a blue-listed perennial herb that grows in wet to moist meadows and streambanks in the montane zone (Klinkenberg, 2015). It can also be found in alpine seepage and calcareous silt near waterfall spray zones. They have been observed in Bear Falls (approximately 2 km away).

**Dainty moonwort** is a blue-listed small perennial fern that usually grows in wet, marshy, and springy areas, including marshy meadows, edges of marshes, saturated soils of seeps, bottoms and stabilized margins of small streams, and (occasionally) wet roadside swales, ditches, and drainage ways (BC CDC, 2017). Individuals were found near the gravel pits in Beaver Valley.

**Crested wood fern** (aka Buckler Ferns) is a blue-listed evergreen perennial fern. They are typically found in conifer forests, riparian areas, wetlands, and meadows (BC CDC, 2017). They have been observed in Bear Falls (approximately 2 km away).

**Mountain moonwort** is a red-listed small perennial fern with a single aboveground frond. It is usually in deep litter of springy, mature western red cedar forests, but also in riparian thickets, mesic meadows (BC CDC, 2017), and grassy trail edges (Montana Field Guide 2017). Individuals were found around the gravel pits in Beaver Valley.

The **elliptic spike-rush** is a blue-listed perennial herb with an egg-shaped flower. Its habitat includes shrubby wetland and wet meadows (BC CDC, 2017). Although it has been observed at Roger's Pass, the elliptic spike-rush typically does not exist at elevations above 1000m, therefore the likelihood of encountering this species at the Project area is low.

**Western St. John's wort** (subspecies *nortoniae*) is a blue-listed perennial herb typically found in relatively higher elevations. It grows in moist open sites (eNature, 2017) as well as in grasslands and shrubby meadows (BC CDC 2017). It has been observed on avalanche pathways near the Project area.

### Invasive Species

Preventing the introduction and spread of non-native species within GNP is important as these species can outcompete native and rare vegetation. A query of "2007, 2014, 2015 Frontcountry and Backcountry Weed Survey Data" provided by PCA (Parks Canada, 2015b) identified 26 pre-existing problem invasive

species in close proximity to the proposed Project area. These species are shown with their general locations in **Table 6-4**.

**Table 6-4: Invasive plant species within the Project area**

Scientific Name	Common Name	PCA Priority	Tupper Timber	Tupper 2	Tupper 1	Lens	Single Bench
<i>Agropyron repens</i>	Couch grass	Low	X		X		
<i>Bromus inermis</i>	Brome	Moderate	X		X		
<i>Cichorium intybus</i>	Common chicory	Low	X				
<i>Cirsium arvense</i>	Canada thistle	Moderate			X	X	
<i>Cirsium vulgare</i>	Common thistle	Moderate	X	X			X
<i>Dactylis glomerata</i>	Cat grass	Low			X		
<i>Hieracium caespitosum/pratense</i>	Yellow hawkweed	Moderate	X		X		
<i>Hieracium pilosella</i>	Mouse-ear hawkweed	Very High	X		X	X	X
<i>Hordeum vulgare</i>	Barley	Low			X		
<i>Hyoscyamus niger</i>	Black henbane	Very High			X		
<i>Leucanthemum vulgare</i>	Oxeye daisy	Moderate	X		X	X	X
<i>Lotus corniculatus</i>	Birdsfoot trefoil	Low				X	
<i>Medicago sativa</i>	Alfalfa	Low	X				
<i>Melilotus alba</i>	White sweet clover	Moderate	X		X		
<i>Melilotus officinalis</i>	Yellow sweet clover	Moderate			X		
<i>Phalaris arundinacea</i>	Reed canary grass	Low			X		
<i>Phleum pratense</i>	Timothy-grass	Moderate	X		X	X	X
<i>Plantago major</i>	Broadleaf plantain	Low			X		
<i>Sonchus asper</i>	Prickly sow thistle	Low			X		
<i>Sonchus arvensis</i>	Perennial sow-thistle	Moderate	X	X	X	X	X
<i>Tanacetum vulgare</i>	Common tansy	High	X		X	X	X
<i>Taraxacum officinale</i>	Common dandelion	Low	X		X		
<i>Trifolium hybridum</i>	Alsike clover	Low	X		X		
<i>Trifolium pratense</i>	Red clover	Low	X		X		
<i>Trifolium repense</i>	White clover	Low			X		
<i>Vicia cracca</i>	Tufted vetch	Moderate	X		X		



Of particular prominence in the area are the large number of individuals of oxeye daisy, common tansy, and common and perennial sow-thistles. There are also established communities of Canada thistle and brome at Tupper 1. The species of highest priority to PCA for removal and spread prevention are mouse-ear hawkweeds, common tansy, and one occurrence of black henbane (Parks Canada, 2015b).

Due to the Project activities having an extended interaction with flora, this VC has been carried forward in the assessment. Whitebark pine will be specifically addressed, and non-SARA listed species will be covered under the 'general flora' effects and mitigations.

## 6.6 Fauna

As previously stated, the Project area is located within the ICH Ecoregion. The wetlands and south aspects of the ICH Ecoregion provide an ideal habitat for the northern alligator lizard, Pacific tree frog, long-toed salamander, calliope hummingbird, Nashville warbler, veery, black-headed grosbeak, moose and white-tailed deer (Achuff et al., 1984). Mountain goats and caribou are the only ungulates known to historically occur year-round in GNP while elk and white-tailed and mule deer usually migrate to areas of lower snowfall in the winter months (Gyug and Van Tighem, 1984). Black and grizzly bears are the most widely distributed large carnivores in the Park. Cougars and wolves are recorded very rarely while coyotes occur at lower elevations. Martens, short-tailed weasels and wolverines are the most abundant carnivores. Avalanche pathways in the ICH zone present good habitat for badgers and Columbian ground squirrels. Vegetation mosaics along the floodplains of the larger rivers, deciduous forest on south aspects, and snow avalanche slopes are important bird habitats (Gyug and Van Tighem, 1984).

A condensed list of wildlife species in GNP was compiled for the Project area by querying species ranges assembled by the following data sources:

- Parks Canada Biotics Web Explorer (Parks Canada, 2013);
- BC Ministry of Environment Species Ecosystems Explorer (BC CDC, 2017);
- BC Conservation Data Centre web application (BC CDC, 2008a);
- Interviews with MRG FU staff (Taylor et al., 2016); and
- Threatened bird, amphibian, mammal, and reptile ranges as assembled by the International Union for Conservation of Nature (IUCN, 2015)

Each data source was searched to find the most site-specific data possible. The Parks Canada Biotics Web Explorer was queried for regularly occurring species listed under SARA Schedule 1 and identified by COSEWIC within GNP (**Appendix 5**). The BC Species and Ecosystems Explorer was utilized to find provincially-listed wildlife species under SARA Schedule 1 and identified by COSEWIC using the appropriate environment region, forest district, regional district, and BEC zone within GNP (**Appendix 5**). To locate documented species occurrences within 2 km of the Project area within GNP, the BC CDC iMap (BC CDC, 2013) was used (**Appendix 5**). The IUCN data set was queried to find threatened bird, amphibian, mammal, and reptile species ranges for BC by habitat type (e.g. temperate forests, rocky areas, and alpine wetlands).



A total of 10 wildlife species of management concern were identified as potentially using the Project area at various stages of the year. Species include two amphibians, two specific bird species (although many others fall under the *Migratory Birds Convention Act*) and six mammals (**Table 6-5**). Six of these species are listed under SARA Schedule 1 and nine species are identified by COSEWIC as special concern, threatened, or endangered species.

**Table 6-5: Wildlife species listed under SARA Schedule 1 and identified by COSEWIC in GNP with potential occurrence in the Project area**

Common Name	Scientific Name	GNP Presence <sup>1</sup>	COSEWIC Status <sup>2</sup>	SARA Legal Status <sup>3</sup>	BC List Status <sup>4</sup>	Potential for Presence in the Project Area
<b>Amphibians</b>						
Western toad	<i>Anaxyrus boreas</i>	R	Special Concern	Special Concern	Blue	Very Low – Very low habitat suitability observed during 2017 biophysical survey
Coeur d'Alene salamander	<i>Plethodon idahoensis</i>	NR	Special Concern	Special Concern	Yellow	Nil – 2017 assessment found no suitable habitat and no individuals.
<b>Birds</b>						
Olive-sided flycatcher	<i>Contopus cooperi</i>	R	Threatened	Threatened	Blue	Medium – low suitability edge habitat in project area; however, known to use area
Barn swallow	<i>Hirundo rustica</i>	R	Threatened	No status	Blue	Low to Medium – though habitat exists, no barn swallows were observed during the Barr's 2017 biophysical assessment conducted on June 26 2017.
<b>Mammals</b>						
Grizzly bear, western population	<i>Ursus arctos</i>	R	Special Concern	No status	Blue	High – dens at higher elevations, but forage habitat present; many observations.
Mountain goat	<i>Oreamnos americanus</i>	R	No status	No status	Blue	High – migration paths, salt on the roadside create salt licks; frequent observations at Single Bench, Tupper 1 and Tupper 2
Wolverine, western population	<i>Gulo gulo luscus</i>	NR	Special Concern	No status	Blue	Medium – high quality habitat present, but low probability of occurrence; incidental observations at Tupper Timber

Common Name	Scientific Name	GNP Presence <sup>1</sup>	COSEWIC Status <sup>2</sup>	SARA Legal Status <sup>3</sup>	BC List Status <sup>4</sup>	Potential for Presence in the Project Area
Little brown myotis	<i>Myotis lucifugus</i>	R	Endangered	Endangered	Yellow	Very Low - potential roost trees present, but generally found in low densities with patchy distribution
Northern myotis	<i>Myotis septentrionalis</i>	R	Endangered	Endangered	Blue	Very Low - potential roost trees present, but generally found in low densities with patchy distribution
Woodland caribou, southern mountain population	<i>Rangifer tarandus</i>	NR	Endangered	Threatened	Red	Low – however, critical habitat present adjacent to Project area. Mainly using area between November and April

<sup>1</sup>R - Regularly-occurring species and NR - Non-regularly occurring species in GNP (Parks Canada, 2013)

<sup>2</sup>COSEWIC - Committee on the Status of Endangered Wildlife in Canada (Government of Canada, 2017a)

<sup>3</sup>SARA - Species at Risk Act (Government of Canada, 2017b)

<sup>4</sup>Red - Extirpated, endangered, or threatened species, blue - special concern species, yellow - secure species and not at risk of extinction (BC CDC, 2017)

#### SARA Listed Species:

The following species have a higher probability of being found in the Project area, or have a SARA/COSEWIC status of importance. Unless otherwise noted, habitat descriptions were provided by the SARA registry website (Government of Canada, 2016) or the BC Conservation Data Centre Species Ecosystems Explorer (BC CDC, 2017).

**Western toad** habitat is diverse, and can include natural or disturbed areas that are forested or shrub growth, such as those found in avalanche pathways. They are active from late winter to fall. Western toads breed in lowland wetlands including shallow, sandy margins of ponds, streams, rivers, geothermal springs, and roadside ditches. Depressions and ditches with collected water (due to poor drainage) are ideal western toad breeding habitat. Adults may forage in breeding areas or disperse to other wetlands, riparian areas, or upland sites, with some occasional long distance excursions of up to 7.2 km (COSEWIC 2002). Upland sites are used for maturation of toadlets and hibernation (typically underground from November to April). Western toads typically return to the same breeding sites each year (COSEWIC 2002). Toadlets are known to migrate from breeding grounds to upland areas en masse. No adults, eggs, or larvae were observed by Barr during the 2017 amphibian assessment, and habitat suitability was determined very low.

**Coeur d'Alene salamanders** are entirely terrestrial and do not breed in water. They are found from 500 to 1550 m elevation (Ohanjanian, 2004). Although the project area is located well within this range (between 1130 m and 1270 m), the highest Coeur d'Alene salamanders have been observed in Mount Revelstoke National Park is 980 m (Larson, 2009). These salamanders prefer very moist crevice habitats by seepages, waterfall splash zones, and wet riparian areas, generally in steep terrain. During non-winter

months, their near-surface habitat can include rock slabs, moist cracks in bedrock, deep moss, and coarse woody debris in the wetted areas of streams (Ohanjanian, 2004). Loose material near ponded water, culvert outfalls, and damp collapsed snowsheds in the Project area could potentially be habitat for these salamanders. They are primarily nocturnal, breed in the spring or fall, and hibernate in winter in deeper crevices. A Coeur d'Alene salamander population was confirmed at Bear Creek Falls (PCA MRG FU, 2016). The 2017 amphibian assessment conducted by Barr did not identify adults, eggs, or larvae, and found no suitable habitat.

**Olive-sided flycatchers** are most often associated with open areas containing tall live trees or snags for perching. Open areas may be forest clearings, forest edges located near natural openings (i.e. avalanche pathways) or human-made openings. Most nesting sites contain dead standing trees, which are used as singing and feeding perches. Nests are placed most often in conifers, on horizontal limbs 2-15 meters from the ground. The forests surrounding the avalanche pathways make ideal olive-side flycatcher habitat. Other migratory birds besides the olive-sided flycatcher are known to use the area from May to September, and PCA uses the general bird nesting window April 1 – August 31 in GNP (Government of Canada 2016; Backman and Boyle 2016).

A Section 83 exception from SARA "Measures to Protect Listed Wildlife Species" for olive-sided flycatchers was secured May 26, 2016. This allows the restrictions in SARA Section 83 to be bypassed in order to facilitate the operations required for the avalanche control program. However, exceptions do not exist under the *Migratory Birds Convention Act*.

The nearest **Woodland caribou** have been observed in the vicinity of the Project area is in habitat around Loop Brook, generally between November and April. Their preferred winter habitat is mature and old-growth coniferous forests that contain large quantities of lichens. These forests are generally associated with marshes, bogs, lakes, and rivers. In summer, the caribou occasionally feed in young stands, after fire or logging. Avalanche pathways would support similar new growth. Woodland caribou rely on strong spatial separation from predators. A Section 83 exception from SARA "Measures to Protect Listed Wildlife Species" for woodland caribou (Southern Mountain Population) was secured May 26, 2016, for operations required for the avalanche control program.

**Little brown myotis** and **northern myotis** use a wide range of natural habitats (e.g. caves and hollow trees) as well as human-made structures for resting and maternity sites. Foraging usually occurs in woodlands near water. Winter hibernation sites include caves, tunnels, abandoned mines, and similar sites. Maternity colonies are commonly in warm sites in buildings and other structures, but also infrequently in hollow trees. Suitable roosts exist in the area in the form of tree hollows, as well as archeological artifacts like old snowsheds. A Section 83 exception from SARA "Measures to Protect Listed Wildlife Species" for little brown myotis and northern myotis bats was secured May 26, 2016, for operations required for the avalanche control program. The Barr 2017 biophysical assessment identified low habitat suitability in the Project area.

### Other Species:

**Barn swallows** nest in and on artificial structures, including barns and other outbuildings, garages, houses, bridges and road culverts. They prefer various types of open habitats for foraging, including grassy fields, pastures, various kinds of agricultural crops, lake and shorelines, cleared rights-of-way, cottage areas and farmyards, islands, wetlands and subarctic tundra. The snowshed structures and the road culverts offer potential for barn swallow nesting. Exceptions do not exist under the *Migratory Birds Convention Act*. No barn swallows or nests were observed during Barr's biophysical assessment conducted 1-3 July 2017.

**Grizzly bears** occupy many different habitat types including subalpine forests in BC. In mountainous areas vegetation emerges earlier at lower elevations; therefore grizzlies will descend from their denning sites to feed in the spring, and return later in the season to higher elevations. They are found on valley bottoms during the snow-free period, and commonly forage on roadsides. Grizzly bears are opportunistic omnivores, eating grasses, bark, roots, mushrooms, berries, fruits, insects, large and small mammals, fish, and carrion. They are also known to eat human garbage if the opportunity presents. The Project area provides suitable habitat in the form of a conduit from high to low elevation, with berry bushes and early succession root vegetation (ideal bear forage) also known to grow in slide-paths. Avalanche paths are important for grizzly bears. Grizzly bears have been observed in the Project area.

**Mountain goats** are found in alpine and subalpine habitats, usually at or above the tree line. Steep grassy talus slopes, grassy ledges of cliffs, or alpine meadows may be occupied. In the Project area, mountain goats migrate up and down mountains between summer and winter and may shelter in lower elevation spruce or hemlock forests in winter. In the spring and summer, they may be attracted to residual salts along TCH. Mountain goats are most active from dawn to mid-morning and from late afternoon to evening. Avalanche pathways make ideal conduits for seasonal migration.

Mountain goats are known to use the sides of the snowsheds as a conduit from higher slidepath elevations to highway level. Vehicle strikes and goat mortality currently exists near the snowsheds, as the goats descend and immediately dart in front of vehicles exiting the snowsheds (Taylor et al., 2016). Mountain goat trails were observed at and between Tupper 1 and Tupper 2 snowsheds during the Barr 2017 biophysical assessment (1-3 July), and hoof prints were observed on both sides of the highway at this point. Clevenger et al. (2014) identified Tupper 1 and Single Bench snowsheds as the highest priority for mountain goat crossing mitigation measures.

**Wolverine** need vast undisturbed areas to maintain viable populations. They inhabit a variety of tree and treeless areas at all elevations including the northern forested wilderness, and the alpine tundra of the western mountains. The wolverine is most abundant where large ungulates are common. The Project area is considered "high quality habitat" in that the area supports "reproductive females well distributed across the landscape characterized by abundant, well-distributed ungulate populations, topographic relief inclusive of preferred maternal habitats, and low human population densities." (Lofroth and Krebs, 2007). The population density of wolverines was estimated at 6.2 wolverines per 1,000 km<sup>2</sup>. With a disturbance area of 43,460 m<sup>2</sup>, statistically, one wolverine uses the snowshed areas for 0.03% of its range, however, the

avalanche pathways above and surrounding forest are also high quality habitat. However, Krebs and Lewis (2000) found the specific Project area are medium- to low-use wolverine habitat. Incidental wolverine observations have occurred at Tupper Timber.

Due to the Project activities having a potential interaction with fauna and its habitat, this VC has been carried forward into the effects analysis. SARA-listed species will be individually addressed, and non-SARA listed species will be covered under the 'general fauna' effects and mitigations.

## 6.7 Cultural Resources

The proposed Project area is within the Rogers Pass National Historic Site of Canada which is a historic travel corridor through the Selkirk Mountains. Its recognition refers to the cultural landscape and resources associated with the 1885 railgrade of the Canadian Pacific Railway (CPR) along the TCH route. As such, cultural resource interaction in all phases of the project is possible, therefore this VC will be carried forward into the effects analysis.

An Archaeological Overview Assessment (AOA) conducted by Aaron Osicki, Terrestrial Archaeologist (Osicki, 2017) (**Appendix 7**) provided a list of archaeological sites within the vicinity of the Project area. The AOA report was augmented by a screen of the proposed Project area against the PCA database of archeological/cultural resource sites (Government of Canada, 2012) and the Federal Historic Places Register (Parks Canada, 2016a). Eight locations of cultural significance were identified as described in **Table 6-6**.

**Table 6-6: Heritage resources located in proximity to the Project areas (KM17.0 – KM20.0) in GNP**

Start km	End km	Relation to Project	Common Name	Archaeological Site Number
16.5	17.0	~65 m NW of the Project (Tupper Timber Snowshed)	Snowshed No.5 - rail feature, snowshed	Site 410T5
17.0	17.5	~40 m NW of the Project (Tupper Timber Snowshed)	Snowshed No.6 - rail feature, snowshed	Site 410T6
17.0	17.5	~80 m NE of the Project (Tupper No.2 Snowshed)	Snowshed No.7 - rail feature, snowshed	Site 410T7
17.5	18.0	~160 m NW of the Project (Tupper No.2 Snowshed)	Snowshed No.8 - rail feature, snowshed	Site 410T8
19.0	19.5	~50 m NW of the Project (Lens Snowshed)	Historic Settling/ Storage Water Tank	Site 1998T
19.0	19.5	~190 m NW of the Project (Lens Snowshed)	Snowshed No.12 - rail feature, snowshed	Site 410T9

Start km	End km	Relation to Project	Common Name	Archaeological Site Number
19.5	20.0	~70 m SE of the Project (Single Bench Snowshed)	Rail feature - Wooden culvert	Site 410T10
19.5	20.0	~40 m SE of the Project (Single Bench Snowshed)	Snowshed No.13 - rail feature, snowshed	Site 410T11

The AOA concluded that there were no archaeological concerns associated with the proposed Project activities (Osicki, 2017). However, due to the potential for Project activities impacting yet-to-be discovered archaeological artifacts, this VC will be carried forward in the assessment. Other cultural features that have been observed within GNP include Culturally Modified Trees and Beehive Ovens.

## 6.8 Visitor Experience and Safety

The Rogers Pass Discovery Centre, a visitor's and interpretive centre, is located approximately 3 km southwest along the TCH from Single Bench Project area. In terms of recreational activity, in GNP there are approximately 20 designated hiking trails, three easily accessible campsites and one backcountry campsite located approximately 3 km NW of the Project area. Hermit hiking trail is located about a kilometer from Single Bench Project area. There are designated nearby Ski Touring Access Routes for Tupper, and Hermit Winter Restricted Areas (Parks Canada, 2016b). The Project area is classified as Winter Restricted, meaning that it can only be accessed by those with a Winter Permit on days when the area is posted as open, when there is no chance of artillery fire happening in the area.

The Project area parallels the path of the 1885 CPR railgrade whose history is a draw for campers and hikers in GNP. Visitors on day-trips also use the Hermit trail for hiking and access to the backcountry campsite at the trail terminal and mountain climbing. The trail is known for ski-touring and mountaineering access in the winter. The local of the Project area is generally known for ski mountaineering, camping, hiking and mountain climbing.

In terms of transportation, the TCH is the only major highway and mode of transportation through GNP registering an average of almost half a million vehicles in the months of September, October and November each year (CornerStone Solutions, 2015). The only other method of transporting commercial goods is via the CPR, located adjacent to TCH.

The objective of this project is to better drain the snowsheds so that structural integrity is maintained and water does not drain onto the highway below. In the past, water on the highway has posed a safety issue particularly in the winter season when it freezes. In addition, lock-block steps in the design of Tupper 1, Tupper 2 (where possible), and Single Bench snowsheds aim to provide a pathway for mountain goats across the TCH to reduce vehicle collisions. Since the project objectives specifically aim to improve safety, and therefore visitor experience, this VC is being carried forward into the effects analysis.

It should be noted that 2017 is expected to be a year of increased visitor traffic above baseline to the National Parks due to the 150<sup>th</sup> anniversary of Confederation and the free park pass promotion.

## 7.0 Effects Analysis

Effects analysis considers the possible interactions between the Project infrastructure components and activities and the VCs, within the identified spatial boundaries. Project interactions may be direct or indirect and may cause a positive or negative impact. Potential effects of the Project on the VCs are determined by comparing the existing conditions to those which are expected to result from the construction and operation of the Project. **Tables 7-1** and **7-2** below highlight how each of the VCs are anticipated to be affected during the various Project phases. Note that these effects do not consider the adoption of planned mitigation measures identified in Section 8, which will largely control/minimize the potential effects identified in these tables. A residual environmental effect is the resultant change in the environment after the application of mitigation measures. The significance of residual effects (after application of mitigation) is assessed in Section 11.

Table 7-1: Potential effects on VCs during preparation/construction

Valued Components		Potential Effects
Air Quality and Noise	General	Excavation, grading, use of machinery, transportation of materials and equipment may result in increased road dust and vehicle emissions above baseline conditions.
		Preparation of cement mixtures, and use of lubricants and fuel for equipment may release volatile organic compounds (VOCs) and other airborne chemicals.
		Increased ambient noise and localized temperature impacts may occur through machinery operation and removal of shade-providing trees.
		Vegetation clearing may reduce noise buffering capacity and reduce air pollution sequestration.
Soil and Landforms	General	Excavation, grading and soil cuts, and cut and fill activities may result in negative changes to slope stability and/or susceptibility to erosive forces.
		Construction activities involving soil stripping and/or compaction may have negative impact on the soils.
		Accidental spills or leaks during transportation, construction, or installation may adversely affect soils.
		Undersized culverts and installation of impermeable liners may increase water flow rate, creating areas of high erosion and scouring at the outlet.
		Previously contaminated soil may be discovered during construction activities. Remediation of (or removal of contaminated soil from) these areas will be a positive effect on soil condition.
		Placement of impermeable ditch lining and localizing water runoff will reduce future erosion potential by the water flowing from the upslope of the snowsheds.
Surface Water	General	Accidental spills or leaks during construction and installation may adversely affect surface water.
		Fuels and materials stored at temporary staging areas have the potential to leak and could wash into drainage ditches ending up in Connaught Creek.
		Stripping, handling, or storing of soils may create sedimentation, which can be released into watercourses downstream, causing increased turbidity and water quality degradation.

Valued Components		Potential Effects
		Increased sediment deposition in culverts during pre-disturbance and construction may result in reduced drainage capacity and flooding.
		Undersized culverts may be more easily blocked, resulting in reduced drainage capacity and flooding.
		Removal of blockages from existing culverts may result in excess water conveyance and drainage of established wetlands.
		Dust generated during construction activity may affect nearby aquatic habitats when dust settles.
		Riparian areas may be temporarily disrupted between construction and revegetation. Riparian areas act as a natural filter to runoff entering surface water.
Fish and Fish Habitat	General	Construction activities have the potential to release deleterious substances into drainage ditches that discharge into fish habitat (Connaught Creek).
		Increased sediment deposition in drainage ditches and culverts during pre-disturbance and construction may end up in Connaught Creek after future rain events. This may cause serious harm to fish and fish habitat.
		Aquatic habitat may be destroyed or harmfully altered if construction activities occur within or adjacent to the riparian zone along Connaught Creek.
Flora	General	Vegetation clearing for snowsheds, embankments, access roads construction, grading and widening of ditches may disturb rare plant species
		Project activities will result in permanent loss of approximately 0.14 ha of vegetation communities for access road construction. Slide path vegetation on the top of the snowsheds is anticipated to re-establish after drainage features and liners are installed.
		Soil disturbance and staging areas may create habitat conducive to non-native invasive species, in competition with native and/or rare species.
		There is potential for impact on dainty moonwort and mountain moonwort if any of the gravel pits in Beaver Valley will be used for material storage or source for construction material.
		Invasive species and/or noxious weeds may be introduced or spread during construction.
		Alteration of slopes while creating drainage ditches may temporarily or permanently remove habitat for slope-dependent species.
	Whitebark pine	Construction of access roads may alter slopes impacting whitebark pine (if present).
Fauna	General	Accidental fuel or oil spills from construction equipment may negatively affect wildlife and habitat quality through contamination of soil, vegetation, or water resources.
		Noise from construction operations may cause avoidance behaviors from wildlife, which would otherwise occupy the land adjacent to roads or use Connaught Creek as a water source. Conversely, some species, specifically grizzly bears, may be curious about the site leading to human interactions. Mountain goat trails were observed at and between Tupper 1 and Tupper 2 snowsheds July 1-3, 2017.
		Garbage and food waste generated by construction activities may attract wildlife and lead to human-wildlife conflict.



Valued Components		Potential Effects
		Construction staging and stockpile areas may temporarily impact wildlife habitat use and migration patterns.
		Removal of trees for construction of access roads may disturb wildlife, especially if clearing is done during breeding, nesting, roosting or rearing seasons.
		Increased traffic during the Project operation period may increase species mortality along TCH.
	SARA listed species	Western toad
		Impact to breeding and foraging habitat (e.g. roadside ditches) from ditch re-grading and culvert excavation.
		Potential species mortality along TCH due to increases in construction vehicle traffic during the Project construction period. Toads often experience mass mortality while crossing roads during seasonal migrations in late summer and autumn. No toads were observed in the project area during the site assessment in July.
		Coeur d'Alene salamanders
		Potential impacts to breeding and foraging habitat, and mortality of individuals/eggs may result from ditch re-grading and culvert excavation. No salamanders were observed during the site assessment in July.
		Little brown myotis, northern myotis
		Clearing of trees and brush within roadway corridor may result in destruction of bat roost trees and maternity sites and associated bat mortality.
	COSEWIC identified	Woodland caribou
		Potential disturbance of habitat, feeding grounds, and movement patterns during construction.
		Olive-sided flycatcher
		<ul style="list-style-type: none"> <li>Clearing of trees, shrubs, and vegetation from snowshed roofs, embankments, ditches and for construction of access roads could result in destruction of nesting habitat and mortality of active nests.</li> <li>Noise associated with construction equipment and excavation may disturb bird nesting patterns.</li> </ul>
		Barn swallow
		Wolverine
		Potential disturbance of habitat, feeding grounds, and movement patterns during construction.
		Grizzly bear
		Potential disturbance of movement patterns; seasonally migrate from higher rockslide slopes and alpine meadows in the spring and summer to lower elevations in the winter. Animals will potentially be on the highway throughout the construction period.
Cultural Resources	General	Unidentified cultural resource areas near the Project area may be disturbed during both construction and operation phases.
Visitor Experience and Safety	General	Construction operations (i.e. machinery use, excavation, grading, and culvert replacement) may disrupt regular visitor traffic and may result in a negative experience for park visitors.
		Dust, smells, and noise from construction may result in short-term nuisance to park visitors using the TCH corridor.
		Staging and material storage may be considered unpleasant by park visitors.

Table 7-2: Potential effects on VCs during operation/maintenance

Valued Components		Possible Effects
Soil and Landforms	General	Before vegetation can establish on newly created slopes, increased erosive forces may cause instability of slopes.
Surface Water	General	Before vegetation can establish on newly created slopes, increased erosive forces may increase sedimentation into ditches and/or surface water.
Fish and Fish Habitat	General	Reconstructed perched and hanging culverts, or those subject to repetitive debris jams, has the potential to improve connectivity of habitat for aquatic biota and reduce maintenance requirements for the future.
		Undersized or culverts installed in a perched manner may result in increased flow rates which may result in increased erosion and sedimentation into Connaught Creek.
Fauna	General	Increased traffic flow (better road conditions) in Tupper Timber, Tupper 2 (if lock-block steps are not installed), and Lens snowsheds may increase species mortality along TCH at these locations. Wildlife mortality is not expected to increase due to better road conditions at Single Bench and Tupper 1 due to lock-block step structures facilitating safer crossing for wildlife.
		Lock-block steps coming down from the roofs of the Tupper 1, Tupper 2 (if possible) and Single Bench snowsheds may decrease species mortality along the TCH at these locations.
	Western toad	Potential creation of poor (sink) ecological habitat if hydraulic connectivity and culvert flow is not maintained.
Cultural Resources	General	Maintenance activities like cleaning drainage ditches may uncover/disturb previously unidentified cultural resources in the Project area, or artifacts brought into the Project area from snow and debris slides.
Visitor Experience	General	Reconstructed perched and hanging culverts, or those subject to repetitive debris jams, has the potential to improve aesthetics and minimize inconveniences associated with temporary road closures due to water and debris overtopping the roadway during high flow events at culvert sites.
		Cleaning up the snowshed roofs and improving drainage will minimize water infiltration into the snowsheds. The reduction in icy road conditions inside snowsheds will improve visitor safety.
		Lock-block steps installed on the Tupper 1 and Single Bench snowsheds may reduce the number of vehicle collisions, thereby improving visitor safety.

## 8.0 Mitigation Measures

All relevant mitigation measures outlined in the *Parks Canada National Best Management Practices for Roadway, Highway, Parkway and Related Infrastructure* (BMPs; PCA, 2015c) will be followed. These allow an identified suite of well-understood Project activities to proceed such that there will not be resulting significant adverse environmental effects. The BMPs are applicable when the Project activities are routine and repetitive with well understood and predictable effects.

Specific mitigation measures to be followed during the snowshed drainage design work along the TCH are numbered and divided into categories below. If these mitigations conflict with the PCA Highways BMPs, the most rigorous with regard to environmental protection shall be followed.

### 8.1 General Mitigation Measures

1. Before initiation of construction, the selected Contractor will prepare an Environmental Protection Plan (EPP) prepared and certified by a Qualified Environmental Professional (QEP) (e.g. Professional Biologist, Professional Agrologist) in accordance with Parks Canada BMPs and Environmental Procedures. Prior to commencement of construction work, the EPP must also be approved by the MRG FU. The EPP will be submitted to the MRG FU for review a minimum of two weeks prior to construction. The EPP will include, but not be limited to:
  - Details on how the work limits will be marked and procedures to keep operations within the clearing boundaries to minimize damage to vegetation and soil.
  - An overall site Erosion and Sediment Control (ESC) Plan which outlines areas where erosion and sedimentation are likely to occur and the means by which the Contractor proposes to control these issues. In addition a localised ESC plan which directs specific mitigation for a specific location (i.e. at each snowshed) may be required during construction at the discretion of the Departmental Representative, or the ESO.
  - A Spill Response Plan (SRP) that details the containment and storage, handling, use and disposal of empty containers, surplus fuels, or other hydrocarbon products to the satisfaction of the Departmental Representative and the MRG FU ESO and in accordance with applicable federal and provincial legislation. The SRP will include a list of products and materials to be used or brought on site that are considered or defined as hazardous or toxic to the environment. Such products may include, but are not limited to, fuels and lubricants. The Material Safety Data Sheets (MSDS) for chemicals used will be made available on-site. Appropriately sized and stocked spill kits will be on site capable of handling 110% of the largest potential spill. Contractor's staff will be made aware of their location(s) on site and will be trained on spill response procedures.
  - An Emergency Response Plan that outlines procedures to follow in the case of an emergency (e.g. wildlife encounter, equipment malfunction/failure or fire). Jasper Dispatch will be notified immediately if a human-wildlife encounter occurs with a bear, wolf, cougar, wolverine, or any wildlife species of management concern.

- A Fire Prevention Plan which describes the fire prevention equipment (e.g. fire extinguishers) and procedures on-site in the event of a fire. Should a fire occur, Jasper Dispatch and the Fire Duty Officer will be notified immediately.
2. Contractor personnel working on site will be required to attend an on-site environmental briefing conducted by the MRG ESO prior to starting work. The first briefing will occur at the start of construction and will be provided at later dates as new personnel arrive on site.
  3. Prior to use in the Project area and daily during use, equipment and fuel lines will be inspected for leaks and structural integrity, and inspections will be recorded. Detected leaks will be addressed immediately, and spills over 1 L or any spill quantity in water will be reported to the ESO immediately. Equipment stored overnight in staging areas will be stored on tarps with appropriate containment and with drip trays and/or pans under fuel tanks, if required.
  4. Spills (e.g. hydraulic fluids) will be responded to immediately according to the Contractor's SRP. Any absorbent materials used in the clean-up or soils contaminated by the spill will be disposed of in the appropriate facilities and transported in accordance with the federal Transportation of Dangerous Goods Regulations.
  5. Dust generated by Project activities, both in the Project area and on the TCH, will be controlled as necessary by watering down surfaces and ongoing cleanup/maintenance. A Restricted Activity Permit (RAP) will be obtained from the MRG FU for any water withdrawal required within the Park in support of dust suppression or other construction activities.
  6. Any necessary permit applications will be prepared and approved by the MRG FU for work that may affect SARA-listed species, if necessary.
  7. No garbage or debris of any kind will be left onsite. Garbage and/or food attractants will be kept inside vehicles, or in bear-safe garbage bins if they can be arranged for the site, and not kept out in the open, to minimize the risk of wildlife encounters. Food waste will be removed from site on a daily basis.

## 8.2 Air Quality and Noise

8. Equipment, vehicles, and stationary emission sources will be well maintained and used at optimal loads for minimal noise and air emissions.
9. No equipment (motor vehicle or construction equipment) motor will idle when not in use, unless required under extenuating circumstances, and carpooling will be encouraged to reduce air emissions and noise pollution.
10. Stationary emission sources (e.g. portable diesel generators, compressors, etc.) will only be used when necessary.
11. Efforts will be made to minimize the amount of vegetation that is cleared or disturbed at each site so as to maintain the noise buffering capacity.
12. Dust-generating activities will be minimized as much as possible during windy periods.

13. No oils, rubber, tires nor any other material will be burned on site.
14. Areas where chemicals are mixed, applied, cured, or dried will be well ventilated and cordoned off to prevent public exposure. Contractors will wear appropriate PPE while working with such materials.

### 8.3 Soil and Landforms

15. Slope stabilization methods including, but not limited to, catchment and wire netting and grading will be used if appropriate, to help reduce potential slope failures.
16. The area of exposed soil at a given time will be minimized by using techniques such as phased construction activities, retaining vegetation as much as possible, and, following construction works completion, stabilizing the exposed soils as soon as possible using temporary measures (e.g. mulch, erosion sediment control blankets, hydroseeding, plastic sheeting, planting long-term vegetation, etc.).
17. Project activities will be planned and scheduled for dry weather whenever possible. If significant wet weather is encountered, additional measures will be taken to minimize erosion potential. Construction and equipment travel will be minimized during periods of heavy precipitation and excavation activities halted during heavy rainfall events.
18. Erosion- and sediment-control materials will be readily available on-site. Materials may include (but are not limited to) rock, gravel, grass seed (seed mix to be approved by the MRG FU), sediment fencing, staking, and polyethylene sheeting.
19. To minimize soil compaction, equipment will be stored on previously disturbed areas or hardened surfaces (i.e. the laydown areas adjacent to the snowsheds).
20. Topsoil will be salvaged and stored separately to preserve the seedbank. Salvaging of topsoil will not occur during high precipitation, high wind or runoff events. Contingency plans for isolating worksites during high precipitation, high wind and runoff events will be identified in the EPP.
21. If contaminated soils are discovered during excavation activities, work will be stopped. The ESO will be consulted to determine the appropriate course of action for remediation of the contaminated material.
22. Culverts will be designed and installed as to not significantly increase the velocity of the water conveyed.
23. Slopes and drainage channels will be monitored by PCA after construction and revegetation for changes to erosion patterns.

### 8.4 Surface Water

24. To prevent the spread of Whirling Disease, gear and equipment arriving on site to be used in a watercourse or riparian area will be decontaminated according to the protocol outlined in the *Direction for permitted users conducting water-related activities in LLYK* (Parks Canada 2017).

25. Work within 30 m of any watercourse that is likely to cause significant erosion and sedimentation to the watercourse will be monitored by a Qualified Aquatic Environmental Specialist (QAES).
26. Contractors will identify impermeable equipment and vehicle fueling and servicing locations for approval by the Departmental Representative or the ESO. Such locations will have spill catchment countermeasures in place and will not be within 30 m of any watercourse, tributary or drainage ditch which connects to fish habitat or in an area that drains into a watercourse. Tanks, hoses and connections will be inspected prior to use and hose connections will be wrapped and secured with absorbent pads during fuel/oil transfers. Hose length and the number of connections shall be minimized, and dripless connections will be used if possible. Gravity-fed systems are not permitted within the Parks, so manual or electric pump delivery systems shall be used.
27. Fuels, gases, or other deleterious substances will be contained within the appropriate and approved containers, and will not be stored at the Project area where leaks and spills have the potential to seep into groundwater, or enter surface waterbodies. Secondary containment large enough to hold 110% of the volume of the containers will be used. Fuels, gases, or other deleterious substances will be transported according to the federal Transportation of Dangerous Goods Regulations. A RAP will be obtained from the MRG FU for the possession and transport of any fuel volume over 250 L.
28. Contractor will implement the ESC Plan for work undertaken in proximity to watercourses, wetlands, or riparian environments (which includes all the Project area since they are within 100 m of Connaught Creek). Sediment containment tools (e.g. sediment basins, traps or barriers) will be erected in ditches/channels downstream of the active work area, where appropriate. They will be monitored and maintained to prevent collapse under heavy sediment loading.
29. Project activities will be planned for dry weather to allow easier control of sediment, spills, or contaminated runoff. However, if a scheduled activity requires working in wet conditions, the area of work will be isolated and appropriate sediment controls installed to prevent the release of sediment-laden water or other deleterious substances into surface waters and fish habitat.
30. Culverts will be designed to accommodate high-flow conditions and reduce the possibility of blockage and will avoid hanging outlets to minimize erosive potential. Rip-rap will be used to prevent scouring during high flow events.
31. Water collected above blocked culverts will be drained before blockages are removed as to prevent a sudden flux of water downstream.
32. Riparian areas disturbed during construction will be revegetated as to speed up ecosystem recovery. Details of the riparian restoration will be provided the MRG FU for review and approval at least two weeks before restoration activities.
33. Ditches and culverts may be monitored by PCA after construction and revegetation for changes to erosion and sediment loading patterns.

## 8.5 Fish and Fish Habitat

Impacts to fisheries resources will be avoided or mitigated through application of BMPs for working in or around water. Work within 30 m from Connaught Creek will adhere to avoidance and mitigation measures as identified by Fisheries and Oceans Canada (DFO) and specific *Fisheries Act* criteria so that activities near water do not cause serious harm to fish or fish habitat (DFO, 2016).

34. Construction activities with high potential for sediment loading will respect fisheries timing windows. Sensitive spawning and early developmental periods for key fisheries species will be avoided, including bull trout (June 1 - August 31) which have been observed in Connaught Creek. Construction work is scheduled to take place outside of the least risk work window, and a QEP or Qualified Aquatic Environmental Specialist (QAES) will work with staff from the MRG FU to identify additional mitigations measures to be used. The QEP or QAES will prepare an instream works plan (may be part of the EPP detailing mitigation measures to be implemented during works occurring outside the least risk work window. Details of the instream works plan will be provided the MRG FU for review and approval at least two weeks before instream activities commence. A RAP is required for the obstruction or diversion of a watercourse, which includes roadside drainage ditches.
35. Shorelines and banks that might be disturbed by the works will be stabilized immediately and if the original gradient of channel banks cannot be restored, a stable gradient will be restored.
36. If replacement rock reinforcement/armouring is required to stabilize eroding or exposed areas, appropriately-sized, clean rock will be used. Such a rock will be installed at a similar slope to maintain a uniform bank/shoreline and natural shoreline alignment
37. As necessary, work areas will be isolated from flowing water using appropriate means (including, but not limited to, the temporary placement of pre-cast concrete barriers or water bags at the toe of the slope) and follow fish protection guidance identified by DFO (DFO, 2016).
38. Hazardous or toxic products (fuels, lubricants, etc.) will be stored no closer than 30 m from any drainage, wetland, watercourse, and water body. This will prevent/minimize deleterious materials from entering drainages, wetlands, watercourses and water bodies that would result in damage to aquatic and riparian habitat.

## 8.6 Flora

All relevant mitigation measures outlined in the *Parks Canada Best Management Practices for Vegetation Removal in Mount Revelstoke and Glacier National Parks* (PCA, 2015d) will be followed. In addition, the mitigations below will be followed:

39. Pre-construction rare plant field surveys will be conducted in late June and late August by a QEP to coincide with optimal survey windows identified within rare plant survey protocols. The surveys will consist of a reconnaissance level survey combined with a detailed survey in areas with a potential for rare plant species presence. Vegetative species of management concern identified will be communicated to the MRG FU Impact Assessment Coordinator (IAC) for guidance on how these will

be mitigated. Survey results will be used to develop site-specific mitigation measures such as avoiding potentially affected plants, adjusting construction plans, or salvaging/translocating affected individuals. Surveys will be conducted on proposed access roads, snowshed roofs, drainage ditches, and other areas identified during reconnaissance.

40. No clearing of rare vegetation species identified in section 6.1.5 will occur without authorization by the MRG FU and the acquisition of appropriate permits (e.g. SARA), particularly whitebark pine. Clearing or grubbing of any vegetation requires a RAP from the MRG FU.
41. To minimize disturbance of vegetation, all equipment will be stored either on the road or on previously disturbed or hardened surfaces that are cleared of invasive species.
42. Efforts will be made and the Project has been designed to minimize the amount of vegetation cleared or disturbed at each site, with the exception of the snowshed roofs and any opportunity to reduce clearing further during construction will be discussed with the Department Representative. The area to be cleared will be visibly delineated to avoid unnecessary vegetation removal. Such areas will be clearly marked with highly visible materials such as flagging tape to guide equipment operators on the area they are to work in. Equipment operators will take extra caution to avoid mechanical damage on trees and other vegetation outside the designated clearing area.
43. Prior to accessing GNP, the contractor will clean construction equipment to be free of seeds, mud, debris, and vegetative material to prevent introduction of invasive species, noxious weeds and soils from off-site.
44. To minimize migration of invasive species from the Project area identified as problem areas for invasive species (Tupper Timber, Tupper No. 1, Lens and Single Bench), the following mitigations are required for all project areas, regardless of historical invasive species presence:
  - Prior to entry onto new segments of the Project area, equipment that came into contact with soil at previous segments (i.e. clearing, grading, decompaction, or restoration equipment) must be cleaned (blow down/scrape down), and inspected by the FU ESO, where possible and appropriate.
  - If needed, only certified weed-free straw bales should be used for sediment and erosion control.
  - Construction staff and others will be required to scrape mud off their boots and brush seeds and dirt from their clothing before leaving the Project area.
  - Discussion about sites of concern where special attention must be paid to invasive species control will take place between the Contractor and the FU before work commences.
45. All areas that have been disturbed either by heavy equipment or other construction-phase related activities (including lay-down sites, temporary work sites, and material stock pile sites) will be reclaimed as quickly as possible either with reseeding (using seed mixtures approved by the MRG FU) and/ or planting of native shrub stakes and vegetation where appropriate. Seed certificates must be presented to the MRG FU for approval in advance of the seed application.
46. Should surrounding vegetation be disturbed, appropriate measures to re-vegetate and rehabilitate will be implemented using PCA approved methods and FU approved seed mix.



47. All vegetation debris will be removed from the Park unless the MRG FU issues a RAP for burning. The technique and location of the burning would be discussed with, and approved by, the MRG FU.
48. Slope alteration will be minimized to the extent possible to avoid removing habitat for slope-dependent vegetation.

### 8.6.1 Whitebark pine

In addition to the general flora mitigation measures, the following measures to minimize impact on whitebark pine will be followed as outlined in the SARA Section 83 exception discussed in Section 6.6:

49. Site surveys for whitebark pine will be conducted by a QEP prior to commencing construction activities and if individuals are identified, causing harm to or killing of apparently healthy trees will be avoided. Trees will be flagged by the QEP to avoid accidental clearing.
50. Soil piles and backfill material will be set outside of areas with whitebark pine to avoid damage to individuals.
51. If activities on site are likely to affect whitebark pine, a QEP will monitor Project activities for the protection of trees. Damage or mortality of whitebark pine during construction/ installation or operations/maintenance will be documented and immediately reported to the ESO.
52. Mortality of apparently healthy whitebark pine trees caused by Project activities will be compensated through support for recovery work, such as, harvesting and testing of seeds for resistance to white pine blister rust, and planting blister rust resistant seedlings in appropriate areas.

## 8.7 Fauna

### 8.7.1 General wildlife

53. All stipulations of the SARA Section 83 exception as indicated in **Appendix 8** and discussed in Section 6.6 will be followed.
54. Spill prevention, clean-up, and remediation will be completed as described above to prevent exposure of wildlife to contaminated water sources and food stocks.
55. Staging areas will be selected in consultation with the MRG FU to reduce the potential for impacts to wildlife species and their habitats.
56. Construction activities and machinery will be limited to the approved footprint and staging areas as to limit temporary disturbance to wildlife habitat, behavior, and migration.
57. Food and food waste will be securely stored to avoid access by animals. Daily off-site disposal of food wastes and other wildlife attractants will be mandatory.
58. Feeding, harassment, or destruction of wildlife is strictly prohibited. Wildlife encountered within or near the Project areas will be allowed to passively disperse without harassment.
59. The EPP will include a plan to minimize wildlife disturbance, including the time of work, and potentially stopping all activities while potentially dangerous and/or sensitive wildlife is in the

immediate vicinity. Contractors will consult with the MRG FU to determine whether there are reports of wildlife in the immediate vicinity of the Project areas.

60. If active nests, roosts, or dens of species protected by SARA or the MBCA are identified, the Contractor will immediately consult with the MRG FU to determine appropriate mitigation measures.
61. Clearing of vegetation with the potential for wildlife habitat (i.e. nests – described below – dens, hollows, riparian areas, feeding grounds) will be done only with approval of the MRG FU.
62. Construction vehicles will yield to wildlife.

### 8.7.2 At-Risk Amphibians (Western toad and Coeur d'Alene salamander)

63. If ditching work is scheduled to occur within the amphibian breeding season (April 1 to August 31) and the ditches contain water, an amphibian survey will be conducted by a QEP to determine the likelihood of presence or absence of amphibians. If the QEP determines the presence of amphibians within the Project area, the Contractor will immediately consult with the ESO and MRG FU to determine appropriate mitigation measures.
64. Amphibian habitat by the road side (i.e. ditch water) which show no indication of amphibian presence will be removed. Such habitats are considered sink habitats which are often contaminated or situated adjacent to a roadway without proper underpasses and lead to high toad mortalities.
65. Contractor must avoid, as much as possible, the creation of temporary amphibian habitats.

### 8.7.3 Avifauna

66. All vegetation clearing should be planned to avoid the General Nesting Period of Migratory Birds in Canada which for this region is April 1 to August 31 (Environment Canada 2015; Backman and Boyle 2016). If any vegetation clearing or grubbing is required during this period, it will first require the approval of the MRG IAC, and require a nest survey by a qualified avian biologist. It should be noted that nest surveys do not provide conclusive results on the presence/absence of migratory birds and should only be used when the amount of vegetation to be cleared is minimal, otherwise the risk still exists of contravening the *Migratory Bird Convention Act* (MBCA).
67. Should active nests be detected during surveys, consultation will occur with MRG FU staff to determine the appropriate course of action which may include species-specific setback distances until nestlings have fledged. Deterrents approved by MRG FU may also be used. All migratory birds, their nests and eggs are protected under the MBCA. Most bird species occurring in Glacier National Park are migratory species covered under the MBCA.

#### 8.7.3.1 Olive-sided flycatcher

In addition to the general wildlife mitigation measures, the following measures to minimize impact on olive-sided flycatcher will be followed as outlined in the SARA Section 83 exception:

68. If active nests are detected during surveys, the Contractor will consult with MRG FU Resource Conservation staff to determine the best course of action. This may include a 400 m buffer around call/nest sites.
69. Equipment and vehicles will be turned off when not in active use to reduce noise that might have sensory impact on olive-sided flycatcher or influence their nesting behavior.

#### **8.7.4 Mammals**

70. All snowsheds are to have slats reinstalled on the downslope side of the snowshed to prevent snow and wildlife from getting into the sheds.
71. Seasonal fencing will be installed along the entrance/exit of snowsheds during the snow-free period. The purpose is to deter wildlife from crossing the road at the entrance/exit of the sheds and provide motorists a better chance to see the animals before they cross and thereby slow down to allow safe crossing of wildlife. Fencing will be coordinated, installed and maintained by the MRG FU.
72. At Tupper 1 and Single Bench snowshed, construct a simple walkway out of interlocking precast concrete blocks to allow multiple species of wildlife (primarily mountain goats and grizzly bears) to ascend and descend snowshed roofs. Natural fill material will be placed within the lock-block steps. If possible within the spatial limitations of the area behind Tupper 2 snowshed, lock-block steps will also be constructed at Tupper 2.
73. If active burrows or dens are identified within the Project areas, the MRG FU will be consulted to determine an appropriate course of action. Disturbance of important feeding areas (e.g. berry bushes for grizzlies) will also require consultation with the FU.

##### **8.7.4.1 Mountain goats**

74. Temporary fencing may be used to promote mountain goat avoidance of construction zones.

##### **8.7.4.2 Bats (little brown myotis and northern myotis)**

In addition to the general wildlife mitigation measures, the following measures to minimize impact on little brown myotis and northern myotis will be followed as outlined in the SARA Section 83 exception:

75. Removal of large living and dead trees will be avoided between April 1 and September 1 when bats utilize maternity sites or roosting.
76. If removal of vegetation must occur between April and August due to Project scheduling demands, a QEP will conduct pre-disturbance surveys for suitable bat roost trees. Should bat roosts be detected, the MRG FU will be consulted to determine the need for bat presence surveys. If hibernation areas are discovered during tree removal outside the roosting and breeding period, the FU will be notified and options to address the site will be agreed at such a time.
77. Artificial lighting, increased noise, and increased activity near dead and dying trees, which serve as potential bat roost trees will be avoided to the extent possible.
78. If active bat roosts are detected during surveys and if bats are found roosting in or near the Project area the Contractor will consult with MRG FU staff to determine the best course of action.
79. Storage areas will be secured to prevent bats from using them as a roost.

#### 8.7.4.3 Woodland caribou

In addition to the general wildlife mitigation measures, the following measures to minimize impact on Woodland caribou will be followed as outlined in the SARA Section 83 exception:

80. If required, pre-treatment of invasive vegetation will be done outside the window of early spring and late fall, as to promote food stock availability during critical periods.
81. Observations of caribou in debris at the bottom of avalanche paths (or in the Project area) will be immediately reported to the ESO.

### 8.8 Cultural Resources

82. Work will be conducted outside areas of known historical or architectural significance.
83. If workers accidentally find significant isolated cultural resources while they are working, work will cease in the immediate area and the MRG ESO immediately notified. The Project Manager will contact Parks Canada's Cultural Resource Advisor for advice and assessment of significance that will in turn determine the mitigation measure. Significant isolated historic items may include but are not limited to: log cabin foundations, tent platforms, log cribbing retaining features, structural features related to early road construction, or pre-contact resources such as concentrations of tin cans or bottles, butchered animal bone, hearths, stone features, or archeological artifacts.

### 8.9 Visitor Experience and Safety

84. The MRG FU will be kept apprised of timelines, work periods and construction activities so that their staff can provide information to the public to prevent additional safety risks for recreational users in the vicinity of the Project area during construction. A traffic accommodation plan will be prepared and submitted to the MRG FU, which addresses effects on traffic from this and other projects. Work will be restricted to daylight hours unless otherwise requested and appropriately permitted.
85. The Contractor will post road signage (e.g. trucks turning, reduced speed) to improve public safety. All signage will be in English and French.
86. Aesthetically displeasing visual impacts of the work site and staging areas will be reduced by minimizing clearing of vegetation to the extent possible (i.e. only what is necessary to maintain stable slopes and a safe work environment). Construction staging and materials stockpiling will ideally be confined to existing pullouts.
87. During construction and operation periods, the Contractor will follow Project specific requirements set out by HES and its engineering contractor around lane closure and delay, including potential closures of the highway or recreational areas when required for public safety.

## 9.0 Public/stakeholder engagement and aboriginal consultation

Indicate whether public/stakeholder engagement was undertaken in relation to potential adverse effects of the proposed project:

- ☒ No
- ☐ Yes (describe the process to involve relevant parties and indicate how comments were taken into consideration).

Indicate whether Aboriginal consultation was undertaken in relation to potential adverse effects of the proposed project:

- ☒ No
- ☐ Yes (describe the process to involve relevant parties and how the results were taken into consideration).

## 10.0 SARA notification

A SARA notification for a Section 83 Exception for avalanche control projects including this Project (snowshed drainage) was authorized and posted to the SARA Public Registry on May 26, 2016 (**Appendix 8**). No additional SARA notification is required for this project and as such, a SARA-Compliant Authorization Decision Tool was not completed.

## 11.0 Significance of Residual Adverse Effects

Potential effects that can be avoided or mitigated were not considered to have a residual effect. Residual Project effects are those effects predicted to persist even after all prescribed mitigations measures have been implemented. Criteria were established to characterize the residual effects for each Project phase, based on:

- **Direction:** the ultimate long-term trend of the environmental effect (e.g., positive, neutral, negative);
- **Magnitude:** the amount of change in a measurable parameter or variable relative to baseline case (negligible, low, moderate, high);
- **Geographic extent:** the geographic area within which an environmental effect of a defined magnitude occurs (local, regional, beyond regional);
- **Duration/Reversibility:** duration is the period of time that is required until the VC or indicator (measurable parameter) returns to its baseline condition or the environmental effect can no longer be measured or otherwise perceived (i.e., short term, medium term, long term, permanent); reversibility is the likelihood that an indicator (measurable parameter) will recover from an environmental effect (i.e., reversible, irreversible);

- **Frequency:** the number of times during a project or a specific project phase that an environmental effect may occur (i.e., infrequent, frequent, continuous);
- **Probability:** the likelihood the effect will happen (unlikely, possible, certain)
- **Not significant:** the effect (positive or negative) might be detectable, but is not predicted to result in a change in the sustainability of the VC relative to the baseline level
- **Significant:** the effect (positive or negative) is measurable and predicted to result in a change in the sustainability of the VC relative to the baseline level.

An analysis of residual effects on VCs once mitigation measures are in place is shown in **Table 11-1**. If mitigation measures are implemented, no significant adverse residual effects are expected for the VCs as a result of the Project.

Table 11-1: Significance of potential residual effects

Valued Components		Potential Residual Effects <sup>1</sup>	Project Phase	Residual Impact Criteria Rating						Significance
				Direction	Magnitude	Geographic Extent	Duration/ Reversibility	Frequency	Probability	
Air Quality and Noise	General	Excavation, grading, use of machinery, transportation of materials and equipment may result in increased road dust and vehicle emissions above baseline conditions.	Preparation/ Construction	Negative	Low	Local	Short Term	Frequent	Certain	Not Significant
		Preparation of cement mixtures, and use of lubricants and fuel for equipment may release volatile organic compounds (VOCs) and other airborne chemicals.	Preparation/ Construction	Negative	Low	Local	Short Term	Frequent	Certain	Not Significant
		Increased ambient noise and localized temperature impacts may occur through machinery operation and removal of shade-providing trees.	Preparation/ Construction	Negative	Low	Local	Short Term	Frequent	Certain	Not Significant
		Vegetation clearing may reduce noise buffering capacity and reduce air pollution sequestration.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant
Soil and Landforms	General	Excavation, grading and soil cuts, and cut and fill activities may result in negative changes to slope stability and/or susceptibility to erosive forces.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant
		Construction activities involving soil stripping and/or compaction may have negative impact on the soils.	Preparation/ Construction	Negative	Low	Local	Short Term	Frequent	Certain	Not Significant
		Accidental spills or leaks during transportation, construction, or installation may adversely affect soils.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant
		Undersized culverts and installation of impermeable liners may increase water flow rate, creating areas of high erosion and scouring at the outlet.	Preparation/ Construction	Negative	Low	Local	Long Term	Infrequent	Possible	Not Significant
		Previously contaminated soil may be discovered during construction activities. Remediation of (or removal of contaminated soil from) these areas will be a positive effect on soil condition.	Preparation/ Construction	Positive	Low	Local	Short Term	Infrequent	Unlikely	Not Significant
		Placement of impermeable ditch lining and localizing water runoff will reduce future erosion potential by the water flowing from the upslope of the snowsheds.	Preparation/ Construction	Positive	Low	Local	Long Term	Frequent	Certain	Not Significant
		Before vegetation can establish on newly created slopes, increased erosive forces may cause instability of slopes.	Operation/ Maintenance	Negative	Low	Local	Short Term	Frequent	Possible	Not Significant
Surface Water	General	Accidental spills or leaks during construction and installation may adversely affect surface water.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant
		Fuels and materials stored at temporary staging areas have the potential to leak and could wash into drainage ditches ending up in Connaught Creek.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant
		Undersized culverts may be more easily blocked, resulting in reduced drainage capacity and flooding.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant
		Removal of blockages from existing culverts may result in excess water conveyance and drainage of established wetlands.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant
		Dust generated during construction activity may affect nearby aquatic habitats when dust settles.	Preparation/ Construction	Negative	Low	Local	Short Term	Frequent	Certain	Not Significant
		Before vegetation can establish on newly created slopes, increased erosive forces may increase sedimentation into ditches and/or surface water.	Operation/ Maintenance	Negative	Low	Local	Short Term	Frequent	Possible	Not Significant
Fish and	General	Construction activities have the potential to release deleterious substances into drainage ditches that discharge into the aquatic environment, leading into fish habitat (Connaught Creek).	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant

Valued Components			Potential Residual Effects <sup>1</sup>	Project Phase	Residual Impact Criteria Rating					Significance
					Direction	Magnitude	Geographic Extent	Duration/ Reversibility	Frequency	
		Aquatic habitat may be destroyed or harmfully altered if construction activities occur within or adjacent to the riparian zone along Connaught Creek.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant
		Reconstructed perched and hanging culverts, or those subject to repetitive debris jams, has the potential to improve hydraulic connectivity and reduce maintenance requirements for the future.	Operation/ Maintenance	Positive	Low	Local	Long Term	Continuous	Certain	Not Significant
Flora	General	Vegetation clearing for snowsheds, embankments, access roads construction, grading and widening of ditches may disturb rare plant species	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant
		Project activities will result in permanent loss of approximately 0.14 ha of vegetation communities for access road construction. Slide path vegetation is anticipated to re-establish after drainage features and liners are installed.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant
		There is potential for impact on dainty moonwort and mountain moonwort if any of the gravel pits in Beaver Valley will be used for material storage or source for construction material.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant
		Soil disturbance and staging areas may create habitat conducive to non-native invasive species, in competition with native and/or rare species.	Preparation/ Construction	Negative	Low	Local	Long Term	Frequent	Certain	Not Significant
		Alteration of slopes while creating drainage ditches may temporarily or permanently remove habitat for slope-dependent species.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant
	Whitebark pine	Construction of access roads may alter slopes impacting whitebark pine (if present). Presence of whitebark pine in the project area will be confirmed through a pre-clearing survey.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant
	Fauna	General	Accidental fuel or oil spills from construction equipment may negatively affect wildlife and habitat quality through contamination of soil, vegetation, or water resources.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible
Noise from construction operations may cause avoidance behaviors from wildlife, which would otherwise occupy the land adjacent to roads or use Connaught Creek as a water source.			Preparation/ Construction	Negative	Low	Local	Short Term	Frequent	Certain	Not Significant
Construction staging and stockpile areas may temporarily impact wildlife habitat use and migration patterns.			Preparation/ Construction	Negative	Low	Local	Short Term	Frequent	Certain	Not Significant
Removal of trees for construction of access roads may disturb wildlife, especially if clearing is done during breeding, nesting, roosting or rearing seasons.			Preparation/ Construction	Negative	Low	Local	Short Term	Frequent	Certain	Not Significant
Slower traffic speeds during the Project construction period may decrease species mortality along the TCH.			Preparation/ Construction	Positive	Low	Local	Short Term	Infrequent	Possible	Not Significant
Increased traffic flow (better road conditions) in Tupper Timber, Tupper 2 (if lock-block steps are not installed), and Lens snowsheds may increase species mortality along TCH at these locations. Wildlife mortality is not expected to increase due to better road conditions at Single Bench and Tupper 1 due to lock-block step structures facilitating safer crossing for wildlife.			Operation/ Maintenance	Negative	Low	Local	Long Term	Infrequent	Possible	Not Significant
Lock-block steps coming down from the roofs of the Tupper 1, Tupper 2 (if possible), and Single Bench snowsheds may reduce the number of wildlife-vehicle collisions and decrease species mortality along the TCH.			Operation/ Maintenance	Positive	Moderate	Local	Long Term	Frequent	Possible	Significant
SA RA		Western toad	Impact to breeding and foraging habitat (e.g. roadside ditches) from ditch re-grading and culvert excavation.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible



Valued Components			Potential Residual Effects <sup>1</sup>	Project Phase	Residual Impact Criteria Rating						Significance
					Direction	Magnitude	Geographic Extent	Duration/ Reversibility	Frequency	Probability	
			Potential species mortality along TCH due to increases in construction vehicle traffic during the Project construction period. Toads often experience mass mortality while crossing roads during seasonal migrations in late summer and autumn.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant
			Potential creation of poor (sink) ecological habitat if hydraulic connectivity and culvert flow is not maintained.	Operation/ Maintenance	Negative	Low	Local	Long Term	Infrequent	Possible	Not Significant
		Coeur d’Alene salamanders	Potential impacts to breeding and foraging habitat, and mortality of individuals/eggs may result from ditch re-grading and culvert excavation.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant
		Little brown myotis, northern myotis	Clearing of trees and brush within roadway corridor may result in destruction of bat roost trees and maternity sites and associated bat mortality.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant
		Woodland caribou	Potential disturbance of habitat, feeding grounds, and movement patterns during construction.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Unlikely	Not Significant
		Olive-sided flycatcher	Potential change in suitable habitat	Preparation/ Construction	Negative	Low	Local	Short Term	Frequent	Certain	Not Significant
	COSEWIC identified	Barn swallow		Preparation/ Construction							
		Wolverine	Potential disturbance of habitat, feeding grounds, and movement patterns during construction.	Preparation/ Construction	Negative	Low	Local	Short Term	Frequent	Certain	Not Significant
		Grizzly bear		Preparation/ Construction							
		Mountain goat	Potential disturbance of movement patterns; seasonally migrate from higher rockslide slopes and alpine meadows in the spring and summer to lower elevations in the winter. Animals will potentially be on the highway throughout the construction period.	Preparation/ Construction	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant
Cultural Resources	General		Unidentified cultural resource areas near the Project area may be disturbed during both construction and operation phases.	Preparation/ Construction	Neutral	n/a	n/a	n/a	n/a	n/a	n/a
			Maintenance activities like cleaning drainage ditches may uncover/disturb previously unidentified cultural resources in the Project area, or artifacts brought into the Project area from snow and debris slides.	Operation/ Maintenance	Neutral	n/a	n/a	n/a	n/a	n/a	n/a
Visitor Experience and Safety	General		Construction operations (i.e. machinery use, excavation, grading, and culvert replacement) may disrupt regular visitor traffic and may result in a negative experience for park visitors.	Preparation/ Construction	Negative	Low	Local	Short Term	Frequent	Certain	Not Significant
			Dust, smells, and noise from construction may result in short-term nuisance to park visitors using the TCH corridor.	Preparation/ Construction	Negative	Low	Local	Short Term	Frequent	Certain	Not Significant
			Staging and material storage may be considered unpleasant by park visitors.	Preparation/ Construction	Negative	Low	Local	Short Term	Frequent	Certain	Not Significant

Valued Components		Potential Residual Effects <sup>1</sup>	Project Phase	Residual Impact Criteria Rating						Significance
				Direction	Magnitude	Geographic Extent	Duration/ Reversibility	Frequency	Probability	
		Cleaning up the snowshed roofs and improving drainage will minimize water infiltration into the snowsheds. The reduction in icy road conditions inside snowsheds will improve visitor safety.	Operation/ Maintenance	Positive	Moderate	Local	Long Term	Continuous	Possible	Significant
		Increased traffic flow (better road conditions) in Tupper Timber, Tupper 2 (if lock-block steps are not installed), and Lens snowsheds may increase species mortality along TCH at these locations. Wildlife mortality is not expected to increase due to better road conditions at Single Bench and Tupper 1 due to lock-block step structures facilitating safer crossing for wildlife.	Operation/ Maintenance	Negative	Low	Local	Short Term	Infrequent	Possible	Not Significant
		Lock-block steps installed on the Tupper 1, Tupper 2 (if possible), and Single Bench snowsheds may reduce the number of vehicle collisions, improving visitor safety.	Operation/ Maintenance	Positive	Low	Local	Long Term	Continuous	Possible	Significant

<sup>1</sup>Residual effects are those that remain after mitigations have been applied to avoid or reduce potential effects.

## 12.0 Experts Consulted

Include Parks Canada and all other experts. Add as many entries as necessary for the Project.

Department/Agency/Institution: MRG/Parks Canada Agency	Date of Request: October 17, 2016
<b>Expert's Name &amp; Contact Information:</b>	<b>Title:</b>
Alexandra Taylor - <a href="mailto:alexandra.taylor@pc.gc.ca">alexandra.taylor@pc.gc.ca</a>	Environmental Assessment Coordinator
Sarah Boyle - <a href="mailto:sarah.boyle@pc.gc.ca">sarah.boyle@pc.gc.ca</a>	Ecologist Team Leader
Claire Sieber - <a href="mailto:claire.sieber@pc.gc.ca">claire.sieber@pc.gc.ca</a>	Cultural Resource Management Advisor
Natalie Stafl - <a href="mailto:Claire.Sieber@pc.gc.ca">Claire.Sieber@pc.gc.ca</a>	Fire and Vegetation Ecologist
Albert Rand - <a href="mailto:albert.rand@pc.gc.ca">albert.rand@pc.gc.ca</a>	Environmental Surveillance Officer
Bruno Delesalle - <a href="mailto:bruno.delesalle@pc.gc.ca">bruno.delesalle@pc.gc.ca</a>	Resource Conservation Manager
Rick Reynolds - <a href="mailto:rick.reynolds@pc.gc.ca">rick.reynolds@pc.gc.ca</a>	Visitor Experience Manager
Expertise Requested: Various subject areas of expertise	
Response: Various email correspondences after kickoff meeting on October 17, 2016	
Department/Agency/Institution: MRG/Parks Canada Agency	Date of Request: June 8, 2017
<b>Expert's Name &amp; Contact Information:</b>	<b>Title:</b>
Elizabeth Vincer - <a href="mailto:elizabeth.vincer@pc.gc.ca">elizabeth.vincer@pc.gc.ca</a>	Impact Assessment Coordinator
Sarah Boyle - <a href="mailto:sarah.boyle@pc.gc.ca">sarah.boyle@pc.gc.ca</a>	Ecologist Team Leader
Expertise Requested: BIA review and project area expertise	
Response: Edited document received June 27, 2017	

## 13.0 Attachments

1. Original Project Description
2. Construction Drawings
3. Snowsheds MAPBOOK
4. Environmental Impact Analysis Tools: Effects Identification Matrix
5. Criteria Used to Describe Predicted Residual Effects
6. Database Search Results
7. Rare Plants 2002-2008
8. Archaeological Overview Assessment (AOA)
9. Section 83 SARA Exception

## 14.0 Author

<b>Prepared by:</b> Name and Agency: Paul Fraser, P.Biol. Barr Engineering and Environmental Science Canada Ltd.	<b>Date:</b>  July 2017
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## 15.0 Surveillance

Document whether surveillance (also referred to as compliance monitoring or site inspection) will be required to verify that required mitigation measures are implemented.

- ☐ Surveillance is not required
- ☒ Surveillance is required (provide details such as the proposed schedule and the focus of inspections)

## 16.0 Follow-up Monitoring

Follow-up monitoring is:

- ☐ not required
- ☐ required by legislation or policy (indicate basis of requirement – e.g. required by the *Species at Risk Act*, *Fisheries Act*, or the [Parks Canada Cultural Resource Management Policy](#))
- ☒ required to evaluate effectiveness of mitigation measures and/or assess restoration success

The methods, metrics and timeline of follow-up monitoring proposed in the subsequent sections is at the discretion of the MRG FU and may be modified to meet operational requirements of the FU during implementation.

### 16.1 Vegetation Monitoring

The Project has the potential to create habitat conducive to non-native invasive species, in competition with native and/or rare species. Several mitigations were recommended (Clevenger et al. 2014) to minimize the introduction of invasive and non-native plant species. To implement mitigation measures effectively, follow-up monitoring is proposed which will involve verifying the effectiveness of measures implemented to mitigate adverse environmental effects of the Project, and detecting unforeseen environmental effects. Monitoring will extend through the site preparation, construction, operation, and maintenance phases, up to five (5) years post-construction or when the monitoring targets below are met, whichever comes first. The contractor will be responsible for monitoring restoration success during the one year warranty period, after which the MRG FU assumes responsibility for monitoring, including implementation of corrective actions.

Success of reclamation will be measured against the monitoring metrics and targets as prescribed by MRG FU; these are as follows:

- Greater than 90% of live stakes and nursery plants after the first growing season (if planted in the spring with dormant stakes from that year), greater than 70% survivorship is planted in the fall;
- By the fifth growing season, at least 50% of native shrub stakes and / or nursery plants should survive;
- Greater than 90% of representative native plant cover by year 5; and
- Less than 10% priority invasive species plant cover by year 5.

In order to determine if metrics are achieved, a qualitative monitoring program will be conducted by the MRG FU. Introduction of non-native species) will be monitored using permanent sample areas. Monitoring will occur at predetermined sites selected prior to the onset of the monitoring program. A series of vegetation plots will be established at random within the cleared area. Plots will be circular with a radius of 1.78 m (which is equivalent to a 10 m<sup>2</sup> area). Plots can be established with the use of a shovel or piece of rebar utilizing a piece of appropriate length string and counting the number of stems, both dead and alive within the area.

Permanently located sampling areas will be used to record the change in vegetation (i.e. introduction of non-native species) that can be systematically monitored through time. The same plots can be used for estimating the percent vegetative cover of both native and invasive species for each plot. Multiple plots should be measured at each site and for each treatment. The collection of vegetation information should occur at a similar time during the growing season to maximize the comparability of data. Where results from the vegetation monitoring plots are not in alignment with the above metrics, remedial actions are described in **Table 16-1**. This table provides the expected remedial actions that are recommended should the results of year-to-year monitoring not be reaching the metrics established above.

**Table 16-1: Remedial actions for vegetation monitoring**

Restoration Objective	Indicator	Remedial Actions <sup>1</sup>
Re-vegetation	Percent cover and density of targeted vegetation <sup>2</sup>	If priority weed species (as defined by MRG) occur on the disturbance feature, implement manual control measures, as required to manage weed populations.

<sup>1</sup> Remedial actions will be site specific and dependent on vegetation community type (upland, lowland, transitional). Proponents and responsible authority should discuss options and expectations prior to undertaking remedial actions.

<sup>2</sup> Note that "targeted vegetation" is focused on native trees and shrubs.

Vegetation monitoring should continue for a period of 5 years, or until the restoration metrics are achieved, whichever comes first.

## 16.2 Wildlife Monitoring

Potential effects from the Project include habitat loss and alteration; and sensory disturbance due to construction, ongoing maintenance and access. Increased public access is a negative effect anticipated with the Project. The anticipated result of this effect is wildlife avoidance. Increased traffic flow (better

road conditions) in Tupper Timber, Tupper 2 (if lock-block steps are not installed), and Lens snowsheds may increase species mortality along TCH at these locations. Wildlife mortality is not expected to increase due to better road conditions at Single Bench and Tupper 1 due to lock-block step structures facilitating safer crossing for wildlife.

Proposed wildlife mitigation measures include lock-block steps at snowsheds with the highest incidence of WVCs (Tupper 1 and 2 (if possible) and Single Bench) and installation of wing fences during the snow-free period to keep wildlife from snowshed entrances (Clevenger et al. 2014). Wildlife mortality is not expected to increase due to better road conditions as a result of the project at Single Bench and Tupper 1 due to lock-block step structures facilitating safer crossing for wildlife. Success of wildlife mitigation will be measured against the monitoring metrics and targets as determined by MRG FU; examples are as follows:

- Use of the snowshed and lock block steps as crossing structures (should increase over time as wildlife habituate). Increases will be based on the number of crossings over a 5 year period.
- Trend reduction in wildlife-vehicle collisions (WVCs): should see a decrease as wildlife use of crossing structures increases and seasonal fencing reduces movement onto the TCH. Reduction will be based on the number of WVCs reduced over a 5 year period, in increments of 5 years from current levels.

Future monitoring of areas experiencing heavy vehicle traffic for incidences of WVCs particularly involving large game species (i.e. mountain goat, moose, elk, deer, bear) should continue. Road-kills should continue to be monitored through Parks maintenance staff, and WVCs reported to MRG Resource Conservation staff in addition to the RCMP. Smartphone apps have been developed and are becoming important tools for the public to report wildlife road-kills (Sandra Macdougall, pers. comm.). Adaptive management strategies should be adopted when available, such as the reduction of speed limits or a restriction placed on public use of access roads if WVC incidences increase or public use of access roads preclude the use of snowsheds as wildlife overpasses. In order to determine if the metrics have been met, compare wildlife presence on roads and WVCs once mitigations are in place (e.g., lock-block steps, wing fences) to current levels. Potential study designs include: Before-After (BA) when no control system is available, or Control-Impact (BI) when no pre-data is available. Since the timing and location of the impact are known and adequate pre-data has been collected, the Before-After-Control-Impact (BACI) design is considered optimal to help isolate the effect of the project from natural variability.

Cameras should be placed at snowsheds to collect information on whether the existing snowshed structures are used by wildlife, what species travel through or over them and during what seasons of the year. Remote cameras can be set out and checked for operation and battery life every 3-6 months. This information will be valuable for assessing the importance of these snowshed structures for safe passage before and after construction of mitigation measures. It is recommended to deploy cameras in fall 2017 to start collecting baseline ("Before") data.

Monitoring is recommended to continue for a period of 5 years. Should the mitigations not achieve the desired targets, the MRG FU will assess further remedial actions at that point in time.

## 16.3 Reporting

As part of the follow-up monitoring process, a report will be prepared after each year of monitoring and maintenance are completed. The report will document the results from the monitoring programs including whether the identified mitigation measures were successful for the environmental effects identified. The report will also document if additional environmental effects occurred as a result of the Project. The report will include a description of:

- Monitoring dates and staff;
- Monitoring protocols;
- Vegetation monitoring plot locations, coordinates, data, results and trends;
- Wildlife remote camera data, , genetics analysis and WVC locations, coordinates, data, results and trends;
- Remedial actions including dates, crew, actions and results, as available;
- Recommendations for future monitoring and/or remediation; and
- A summary of successes and challenges.

## 17.0 Decision

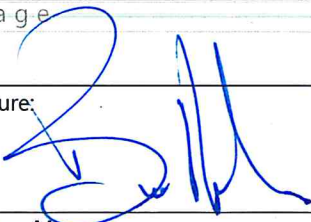

Taking into account implementation of mitigation measures outlined in the analysis, the project is:

- ☒ not likely to cause significant adverse environmental effects.  
☐ likely to cause significant adverse environmental effects.

*NOTE: If the project is identified as likely to cause significant adverse effects, CEAA 2012 prohibits approval of the project unless the Governor in Council (Cabinet) determines that the effects are justified in the circumstances. A finding of significant effects therefore means the project CANNOT go ahead as proposed.*

## 18.0 Recommendation and Approval

<b>Reviewed by:</b>  MRG Impact Assessment Coordinator – Elizabeth Vincer	Date:
IA Specialist Comments:	
<b>Recommended by:</b>  MRG FU Resource Conservation Manager – Bruno Delesalle	Date:

Signature: 		Date: Aug 11/2017
Approved by: Field Unit Superintendent – Nicholas Irving		
Signature: 		Date: Aug 11, 2017

## 19.0 National Impact Assessment Tracking System

The project must be registered in the [Parks Canada National Impact Assessment Tracking System](#) within the fiscal year the project took place. If the project is on hold, was cancelled, or was determined to be likely to cause significant adverse effects and did not proceed, please indicate this information in the tracking system (see selections in the *Assessment Status/Decision* field).

☐ Project registered in tracking system

☒ Not yet registered (*CEAA 2012 requires PCA submit a report to Parliament annually. EIAs must be entered in the tracking system **by the end of April** to enable reporting.*)



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## **Appendix 1**

### Original Project Description

## **Appendix 2**

### Construction Drawings

## **Appendix 3**

### Detailed Map Book

## Appendix 4

### Effects Identification Matrix

**Section A** focuses on direct effects of the project; **Section B** on indirect effects caused by changes to the environment.

A. Direct Effects									
			Valued components potentially directly affected by the proposed Project						
			Natural Resources					Cultural Resources	
			Air	Soil & landforms	Water (surface, ground, crossings, etc.)	Flora (specify, including SAR)	Fauna (specify, including SAR)	Historical Resources	Visitor Experience
Phase	Examples of Associated Activities								
Project Components	Preparation / Construction	Supply and storage of materials	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Clearing	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
		Disposal of waste	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Drainage	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Excavation	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
		Grading	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
		Use of machinery	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Transport of materials/ equipment	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Use of Chemicals	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Set up of temporary facilities	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Traffic control	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	Operation	Waste disposal	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Use/Removal of temporary facilities	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Use of chemicals	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Vehicle Traffic	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>



**Section B** may be used to identify potential indirect effects that may result from impacts of the project to components of the environment identified in Section A - direct effects to natural resources. Consideration of indirect effects is required under CEAA 2012 Sections 5(1)(c) and 5(2)(b), and by the PCA mandate. For example:

- *If the proposed project could lead to adverse effects to water quality and quantity, could this then effect the quantity and quality of water resources (e.g. potable water) used by an Aboriginal community?*
- *Could there be adverse socio-economic effects on recreational fishing and tourism?*
- *Could changes to the environment (e.g. digging, clearing) affect visitor access, opportunities, or safety?*

B. Indirect Effects (all phases)								
		Impacts as a result of changes to the environment						
		With respect to non-Aboriginal peoples:	With respect to Aboriginal peoples:		With respect to visitor experience			
			Health and socio-economic conditions	Health & socio-economic conditions	Current use of lands and resources for traditional purposes	Access & services	Recreation & accommod'n opportunities	Safety
Phase	Natural resource components affected by the Project							
Preparation /construction operation /implementation/decommissioning	Could impacts to <u>air</u> lead to adverse effects on...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	Could impacts to <u>soils and landforms</u> lead to adverse effects on...	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	Could impacts to <u>water</u> (e.g. surface, ground water and water crossings) lead to adverse effects on...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	Could impacts to <u>flora</u> (including SAR) lead to adverse effects on...	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	Could impacts to <u>fauna</u> (including SAR) lead to adverse effects on...	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	Other...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

## Appendix 5

### Definition of Criteria Used to Describe predicted Residual Effects

Criteria	Definition	Description
Direction	the ultimate long-term trend of the environmental effect (e.g., positive, neutral, negative)	Positive – net gain or benefit; effect is desirable
		Neutral – no change compared to existing conditions
		Negative – net loss or adverse effect; effect is undesirable
Magnitude	the amount of change in a measurable parameter or variable relative to baseline case (negligible, low, moderate, high)	Negligible – no detectable change
		Low – effect is detectable but within the range of existing values or natural variability
		Moderate – effect is at or slightly exceeds the limits of existing values but unlikely to be a management concern
		High - effect exceeds the limits of existing values. The effect can pose a serious risk and is likely to be a management concern
Geographic Extent	the geographic area within which an environmental effect of a defined magnitude occurs (local, regional, beyond regional)	Local – effect is confined to the Local Study Area (LSA)
		Regional – effect extends beyond the LSA but is within the region (i.e., Glacier National Park)
		Beyond Regional – the effect extends beyond Glacier National Park
Duration/reversibility	Duration is the period of time that is required until the VC or indicator (measurable parameter) returns to its baseline condition or the environmental	Short term – the effect occurs during construction or operation and is reversible before or during operation

	effect can no longer be measured or otherwise perceived (i.e., short term, medium term, long term, permanent)	Medium term – the effect occurs during construction or operation and is reversible upon completion
	Reversibility is the likelihood that an indicator (measurable parameter) will recover from an environmental effect (i.e., reversible, irreversible)	Long term – the effect occurs during construction or operation and persists beyond completion but is reversible
		permanent – the effect occurs during construction or operation and is irreversible
Frequency	the number of times during a project or a specific project phase that an environmental effect may occur (i.e., infrequent, frequent, continuous)	Infrequent – the effect is expected to occur rarely
		Frequent – the effect is expected to occur intermittently
		Continuous – the effect is expected to occur continuously
Probability	the likelihood the effect will happen (unlikely, possible, certain)	Unlikely – the effect is unlikely to occur
		Possible – the effect may occur
		Certain – the effect will occur

## **Appendix 6**

### Database Search Results

## **Appendix 7**

### Rare Plants 2002-2008

## **Appendix 8**

### Archaeological Overview Assessment (AOA)

## **Appendix 9**

### Section 83 SARA Exception