Kicking Horse Canyon Project
Phase 4: West Portal to Yoho Bridge

Environmental Synopsis Report

November 2016

REVISION 4

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

1.0 Background

The British Columbia Ministry of Transportation and Infrastructure (MoTI) has completed preliminary design for Phase 4 of the Kicking Horse Canyon Project (KHCP), part of the Trans-Canada Highway (TCH). The Phase 4 section of the KHCP is located near Golden. The west project limit is 4.2 kilometres east of the Highway 95/TCH intersection, and the east limit is 9 kilometres east of the same intersection as measured along the highway. The project lies between the completed Phase 3 West and Phase 1 portions of the KHCP. The subject of this report is the Phase 4 section.

The purpose of this environmental synopsis report is to provide the following information for the project:

- Summarize results of existing studies and assessments,
- Identify any additional environmental work required prior to construction,
- Identify environmental features and rate their sensitivity,
- Identify potential impacts and rank their severity,
- Identify further study requirements, and
- Identify potential mitigation or enhancement opportunities.

The report provides information required for preparation of an environment assessment for the project, if required, and will be updated and revised as the highway design progresses.

2.0 Project Description

Two alignment options, N1 and M5, were originally developed and studied by MoTI during functional planning studies (SNC-Lavalin 2000b). The M5 option was eliminated due to geotechnical constraints. Several more alignment options were developed during further preliminary design. These include N-B6, N-D2 and Z1 to Z4. In July 2013, MoTI executive requested that the KHCP design team reassess the Phase 4 preliminary design and determine a modified scope and cost estimate that addressed driver safety, highway reliability and capacity. Based on review of the original Z alignments, the design team assessed alignment options and recommended alignment Z9A-D in 2014. The Z9A-D alignment option is the subject of this KHCP Phase 4 Environmental Synopsis Report.

The Z9A-D alignment option is located on the north side of the Kicking Horse River (Figure 1). The alignment may be slightly modified during detailed engineering design but will be within the approximate project area boundaries shown in Appendix 1.

The section of the existing highway to be upgraded is currently two and three lanes wide, with an 80 km/h posted speed limit, 13 substandard curves with advisory speeds signs and poor vertical geometry. The upgraded highway will be four lanes throughout, with a 100 km/h design speed limit. The design specifications are summarized in Table 1.

The project is expected to generate excavated material in excess of project fill requirements. The surplus excavated material will be stockpiled in an existing clear-cut area large enough to accommodate the material, and some may also be used for construction of the new roadbase. All reasonable efforts will be made to revegetate stockpiled material, depending on the suitability of the material as a growing medium.

Traffic will continue to use the existing highway until the new Phase 4 section is complete or will be accommodated with constructed detours within the project site. Extended closures are presently not anticipated. Requirements for traffic stoppages will be considered during subsequent design stages.

Construction will comply with the current requirements of Section 165, Protection of the Environment, in MoTI's *Standard Specifications for Highway Construction* (MoTI 2012). Further, the contractor will be required to prepare and submit an environmental management plan that must be accepted by MoTI and reviewed by the B.C. Ministry of Forests, Lands and Natural Resource Operations; Environment Canada; and Fisheries and Oceans Canada before the start of construction.

Table 1. Phase 4 design specifications

Roadway Design Criteria	Present Conditions	Required Design Standards
Highway Classification	Rural Arterial Undivided	Rural Arterial Divided
Design Speed	Posted 80 km/h, with numerous substandard curved	100 km/h
Basic Number of Lanes	2 and 3	4 throughout
Minimum Radius	148 m	440 m
Maximum Grade:	8%	6% with a short 0.7 km section of 7-8%
Lane Width (through lanes)	3.6 m	3.7 m
Right Hand Shoulder Width	0.8 – 2.0 m	2.5 m
Median Width	N/A	2.6 m

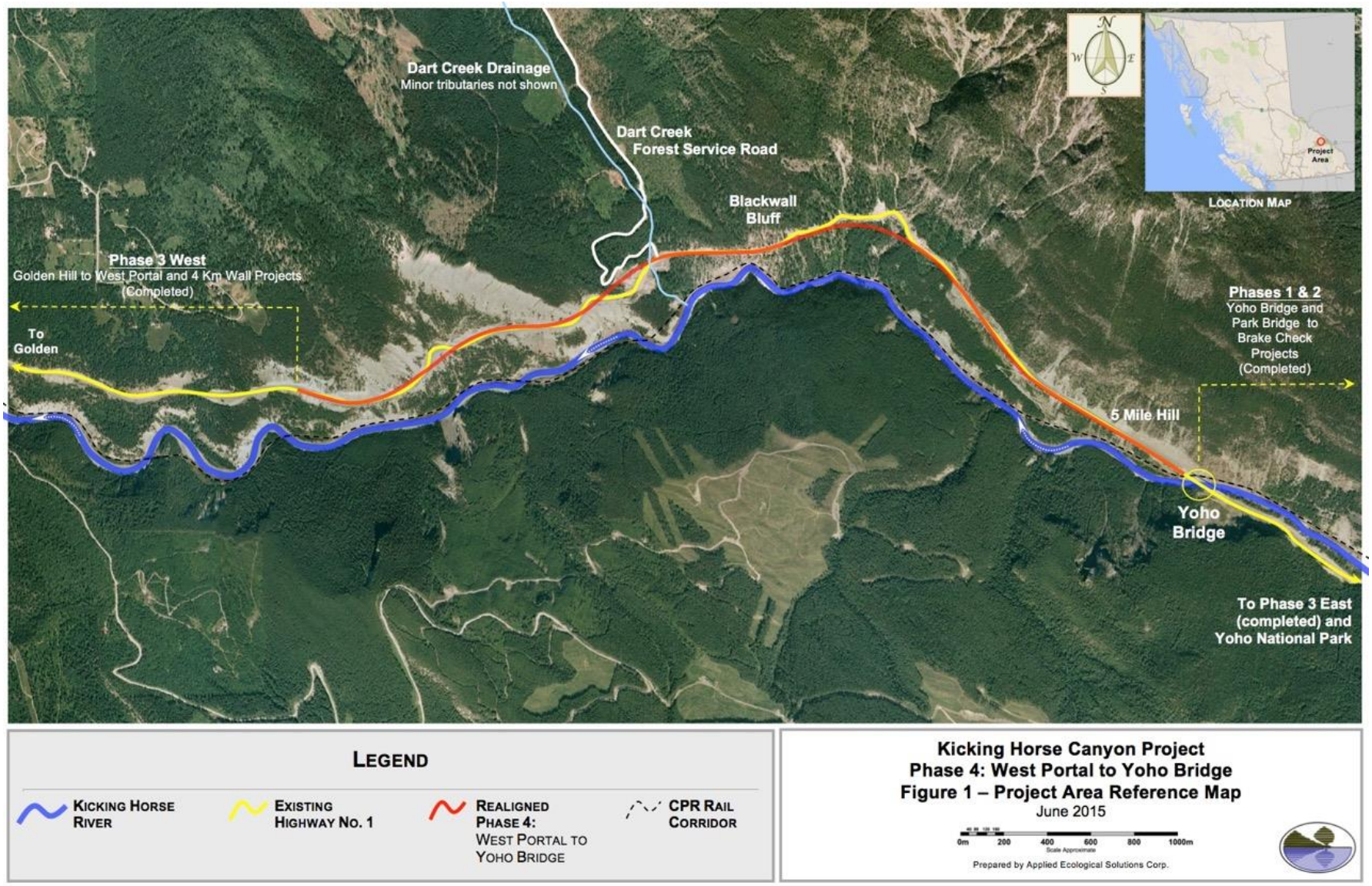


Figure 1. Phase 4 project area

3.0 The Environment

The project is located in the Kicking Horse Canyon, a rugged, mountainous and unpopulated area of the Rocky Mountains between the town of Golden and Yoho National Park.

The project area is forested, primarily with Douglas fir and lodgepole pine, and is inhabited by several species of large mammals, including those listed in section 5.1.3.

The nearest large wetland is located near the Columbia River at Golden, 6 kilometres west of the project. The Dart Creek Valley within the project area has several small areas of swamp or wetland habitats.

The Kicking Horse River, the nearest fish-bearing watercourse, flows east to west south of the project area to Golden, where it joins the Columbia River. Fish species present are listed in section 5.1.2. Originating in the Wapta Icefield, the river is glacier-fed, cold and fast and is ideal for whitewater kayaking and rafting. There are several commercial kayaking and rafting companies operating on the Kicking Horse River.

The CP Rail line follows the north and south banks of the Kicking Horse River south of the project area (Figure 1). CP currently accesses the rail line from the highway at two locations within the project west of the Yoho Bridge.

Areas to the north of the project have been logged in recent years. These logging areas are accessible from the TCH within the project area by way of the Dart Creek Forest Service Road. The area to the south is bounded by the CP Rail line and the Kicking Horse River.

4.0 Methods

The following methods for this report were developed and used for the strategic environmental assessment report on Phase 2 of the KHCP (Kelly 2004).

4.1 Environmental Assessment

This environmental synopsis report was done in four steps:

- The environmental components to be considered were identified,
- A system for ranking the severity of impacts was established,
- Available information was reviewed, and the site was visited, and
- The expected impact on each environmental component was assigned a severity rating.

4.2 Relevant Environmental Components

Highway developments can affect a wide range of environmental components, often including groundwater, surface water, air quality, noise, aquatic vegetation, wetlands, fish and fish habitat, terrestrial wildlife and wildlife habitat, birds and bird habitat, terrestrial vegetation, endangered plants and animals, navigation, recreation, human health, socioeconomic conditions, physical or cultural heritage, First Nations traditional use, and historical, archaeological, paleontological or architectural aspects.

These components are listed, with potential mitigation to offset impacts, in section 5.2. Appendix 2 lists individual environmental features by Landmark Kilometre Inventory (LKI) marker for the

project area along the existing TCH. The LKI is one of MoTI's systems for identifying locations on the provincial highway network.

4.3 Impact Severity Ranking System

This report assigns an impact severity ranking to each of the environmental components. The ranking reflects expert opinion based on existing knowledge. Confidence in the rankings is high because there are no known sources of uncertainty.

The impact severity ranking system was used to help clarify the relative significance of the project's likely effects on the environmental components. The system, shown in Table 2 below, is very similar to the one used for the strategic environmental assessment of the Border Infrastructure Projects in the Lower Mainland and the SHIP Border Projects. Impact ranking considers construction, operation and decommissioning of the highway.

Table 2. Impact severity ranking system

Impact Severity	Definition
Beneficial	Impacts that will have a positive effect on a particular environmental component.
Nil	No measurable effect.
Low	Impacts that can be avoided through project design or reduced to acceptable levels by mitigation.
Moderate	Impacts that are measurable and represent moderate incremental change from existing baseline, with possible long-term consequences. Mitigation may be used to reduce adverse effects and avoid residual impacts.
High	Impacts that are measurable and represent major incremental change from existing baseline, with long-term, irreversible consequences. Although mitigation may reduce adverse effects, residual impacts are probable.
Unknown	Impacts that cannot be ranked due to lack of information.

4.4 Information Review

MoTI has considered upgrading this section of the TCH for more than two decades. Environmental studies — including assessments of effects on fisheries, wildlife, vegetation, birds and archaeology — were conducted to support the functional planning work. Information deficiencies were identified, and potential environmental impacts and appropriate mitigation measures have been identified in the assessment reports and discussed by the project team.

Since 2001 additional detailed studies commissioned by MoTI to consider wildlife and bird habitat, vegetation and archaeological impacts in greater detail and/or to fill information gaps have now been completed for the Phase 4 KHCP. These studies have been reviewed and considered by the design team in their selection of the preferred alignment and will be reviewed again in subsequent detailed design of the highway improvements.

The site was visited by environmental specialists a number of times. Prior to completion of detailed design and construction, field review by environmental specialists is recommended to ensure that appropriate assessment and environmental mitigation are undertaken.

5.0 Results

5.1 Previous Studies

Previous studies for major environmental components of the project area are discussed below.

5.1.1 Potential Metal Leaching/Acid Rock Drainage (ML/ARD)

A preliminary screening of potential ML/ARD issues in Phase 4 was conducted in 2005 by Kevin Morin of Minesite Drainage Assessment Group (Morin et al. 2007). The expanded acid base accounting tests from selected samples of core indicated that the Glenogle units east of Dart Creek could potentially be acid-generating, while the McKay units west of Dart Creek were not likely to be. Thus, excavation work east of Dart Creek will have to include adequate provisions for disposal of surplus material to mitigate potential ML/ARD impacts.

A subsequent assessment was then carried out using long-term kinetic testing to get a better indication of the degree of the potential risk of ML/ARD from the two rock types. These tests began in late 2005 and were completed in early 2007. They confirmed the earlier testing and indicated that the Glenogle units were potentially acid-generating. It was determined that the risks could be mitigated using various techniques, such as those discussed in section 5.2.3.

5.1.2 Fish and Fish Habitat

The Kicking Horse River is considered to be a fisheries-sensitive system. High seasonal turbidity, low water temperature and low levels of nutrients limit fish habitat capability and production in this system.

Enkon Environmental Ltd. (1998) and Coast River Environmental Services Ltd. (2000) conducted fisheries assessments and fish collection programs at stream crossings along the existing TCH for MoT between 1998 and 2000 as part of the Cache Creek to Rockies highway improvement program. Fish habitat conditions and sensitivities are also documented in an existing conditions report prepared by MoT in 1998 (MoT 1998) and in an environmental overview assessment by Acres International Ltd. (1998).

These studies documented that the Kicking Horse River provides spawning and rearing habitat for the fish species listed in Table 3.

Table 3. Fish species present in the Kicking Horse River

Common Name	Species Name
Bull trout	*Salvelinus confluensus*
Rainbow trout	*Oncorynchus mykiss*
Eastern brook trout	*Salvelinus fontinalis*
Kokanee salmon	*Oncorhynchus nerka*
Mountain whitefish	*Prosopium williamsoni*
Pygmy whitefish	*Prosopium coulteri*
Longnose dace	*Rhinichthys cataractae*
Slimy sculpin	*Cottus cognatus*
Torrent sculpin	*Cottus rhotheus*

The studies identified a number of small, unnamed ephemeral tributaries of the Kicking Horse River that cross under the TCH in this section. Dart Creek, a small, non-fish-bearing, groundwater-fed stream, also crosses under the highway in Phase 4. General fish habitat quality is low in Dart Creek and all of these tributaries and is limited by seasonal low flows, steep gradients and poorly defined channels. None of the tributaries have viable fish habitat at the proposed crossing locations or upstream from the highway. They likely provide refuge habitat only in their lowest reach and at confluence areas with the Kicking Horse River downstream from the TCH.

5.1.3 Terrestrial Wildlife and Wildlife Habitat

The project area traverses an area of moderately high wildlife use. Mule deer, white-tailed deer and bighorn sheep occur in substantial numbers throughout the project area, particularly in winter and mostly at the western end (Demarchi and Searing 1997). Lower numbers of elk and moose occur at various times of the year (Demarchi and Searing 1997).

This area is also within a broad movement corridor for ungulates, bears and other wildlife that move east-west along the Kicking Horse River valley (Acres 1998). The area that will be affected by the project provides habitat for several large mammal species. Habitat of this type is locally and regionally common, and habitat loss is not likely to result in populations being reduced beyond normally observed variation.

As part of the Cache Creek to Rockies highway improvement program in the 1990s, LGL Ltd. conducted wildlife surveys (Demarchi and Searing 1997), Timberland Consultants surveyed the mountain goat population (Poole and Walker 2000), Manning, Cooper and Associates conducted wildlife habitat and mitigation assessments (SNC-Lavalin 2000b), and Callaghan et al. (1998) developed a computer model to simulate the movement of wolves in the winter through the Kicking Horse Canyon.

Demarchi and Searing (1997) determined that most local movements of ungulates were predominately north to south, although many seasonal movements are still in a generally east-west direction because, at a landscape level, the Kicking Horse Canyon acts as a wildlife movement corridor to connect the Columbia Valley with the Beaverfoot Valley. The distribution and abundance of mountain goats and the location of mineral licks were documented by Poole and Walker (2000). Although high-quality wolf habitat is limited in the Kicking Horse Canyon, it may function as a regional corridor between the Columbia Valley and the Beaverfoot Valley and Yoho National Park (Callaghan et al. 1998).

Ungulate and bear habitat values assessed by Chytyk et al. (2000) indicate generally high to moderate winter habitat values for deer, elk and bighorn sheep and low to very low winter habitat values for moose within the project area. Bear habitat values during the growing season were mostly low to very low (Chytyk et al. 2000). Ketcheson (2006) found high white-tailed deer and mule deer habitat ratings within the project area and high elk habitat ratings east of Dart Creek. Bighorn sheep habitat ratings of high were not as extensive as they were for the cervid species mentioned earlier but did occur sporadically near the Kicking Horse River and west of Dart Creek (Ketcheson 2006).

Winter snow-tracking and aerial helicopter surveys were used in the project area to determine the relative distribution and abundance of various wildlife species based on tracks and direct observations from January to March 2006 (Harper 2007a). Deer and sheep track densities based on aerial survey were high-moderate in the vicinity of Dart Creek and moderate east of Blackwall

Bluffs. Mountain goats and their tracks were observed on steep, rocky cliffs above Blackwall Bluffs (Harper 2007a). A snow-tracking transect along the Dart Creek Forest Service Road had large animal track densities that were less than transects further west near Golden. Deer accounted for 58% and bighorn sheep for 13% of the total 314 tracks observed (Harper 2007a). There were relatively high levels of predator activity along the Dart Creek transect, mostly cougar and coyote, but also a single lynx track observed on January 20, 2006.

Table 4. Wildlife species present within project area

Common Name	Species Name
Mule deer	*Odocoileus hemionus*
White-tailed deer	*Odocoileus virginianus*
Elk	*Cervus elaphus*
Mountain goat	*Oreamnos americanus*
Bighorn sheep	*Ovis canadensis*
Moose	*Alces alces*
Black bear	*Ursus americanus*
Grizzly bear	*Ursus arctos*
Coyote	*Canis latrans*
Cougar	*Felis concolor*
Gray wolf	*Canis lupus*
Wolverine	*Gulo gulo*

Unmitigated, the wider highway and increased traffic speed are expected to result in increased animal-vehicle collisions. Collision rates for this section of the highway near Golden have been among the highest on the TCH between Kamloops and the Alberta border (Harper and Cooper 1999). Within the project area 10% (12 of 125) of motor vehicle accidents in the Highway Accident System database had “wild animal” as the first contributing factor (SNC-Lavalin 2000a).

Although the faster design speed and straightening of curves in the project area mean that vehicle traffic speed will increase with completion of the project, wildlife exclusion fencing has a proven track record for mitigating these impacts. Preliminary discussion of a potential wildlife exclusion fencing system can be found in an early functional planning report (Harper and Cooper 1999). Wildlife should be able to maintain current movement patterns by crossing under proposed new bridges. Harper (2007b) recommended that wildlife exclusion fencing be installed on both sides of the highway throughout the Phase 4 project area.

The Golden Rod and Gun Club operates a supplemental winter feeding program to feed a herd of bighorn sheep on the south side of the highway in the design section to the west (Phase 3 West) at LKI 3.70. These sheep and other wildlife now use a new wildlife overpass to cross the highway 0.8 kilometres west of the Phase 4 project within the completed Phase 3 West project.

The lambing area for this herd of sheep has been identified at approximately LKI 6.00 within the project area between TCH and the Kicking Horse River (Appendix 1). Potential impacts to the lambing area are avoided because the alignment is located north of the area. Disturbance from construction activities, such as blasting, must be avoided during the lambing period.

5.1.4 Animal-Vehicle Collision Mitigation

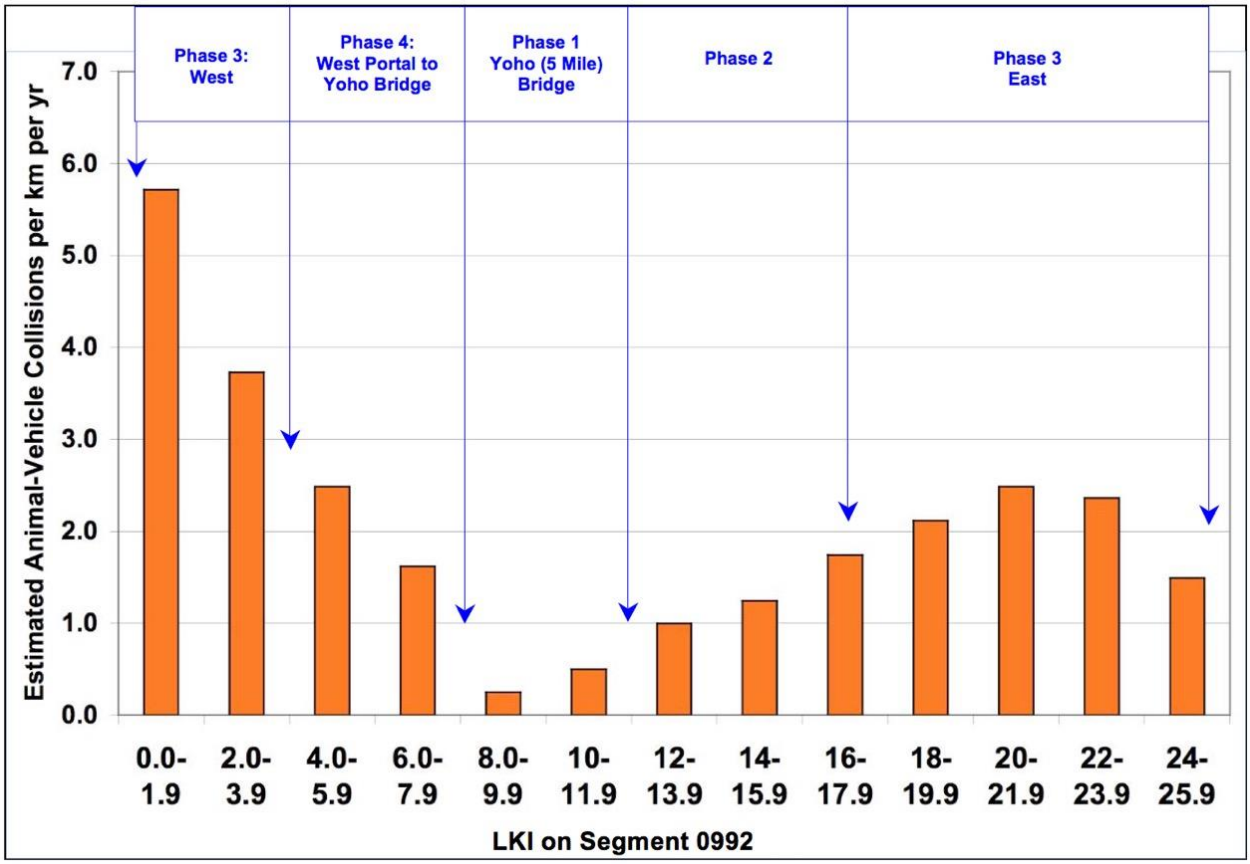
The distribution of animal-vehicle collisions along the TCH between Golden and Yoho (Five Mile) Bridge was analyzed in 2005 by Osiris Wildlife Consulting for the period from 1979 to 2005 using data from the Wildlife Accident Reporting System (WARS 2006) administered by MoTI. Since WARS records only capture a small portion of the actual number of animal-vehicle collisions (Sielecki 2004), a five times correction factor was applied to raw data to generate the estimates presented in Table 5 and Figure 2. These data were analyzed for 2-kilometre sections along the KCHP and summarized for each phase.

For that period, there was an average of approximately 2 animal-vehicle collisions per kilometre per year for the Phase 4 project area. Overall, within the Phase 4 project area 50 to 90% of road kills were deer, up to 10% were elk, up to 7% were moose, and the remainder were other species, including bear, coyote and porcupine. Animal-vehicle collisions in the 1979 to 2005 period were much higher at the western end of the Phase 4 study area near Golden than in the area near Yoho (Five Mile) Bridge.

Table 5. Distribution and species involved in animal-vehicle collisions on the Trans-Canada Highway, Phase 4 between Western Portal and the Yoho (Five Mile) Bridge (1982-1993 inclusive)

TCH Segment 0992 LKI (km)	Estimated Animal-Vehicle Collisions per km per year	Deer	Elk	Moose	Other[1]	Total
4.00 to 5.90	2.5	57%	0%	7%	36%	100%
6.00 to 7.90	1.6	90%	10%	0%	0%	100%
8.00 to 9.90	0.2	50%	0%	0%	50%	100%

1 Other species include coyote, porcupine, bear and unknown.
Source: WARS 2006



Source: WARS 2006

Figure 2. Estimated animal-vehicle collisions along the Kicking Horse Canyon portion of the Trans-Canada Highway based on WARS data from 1979 to 2005

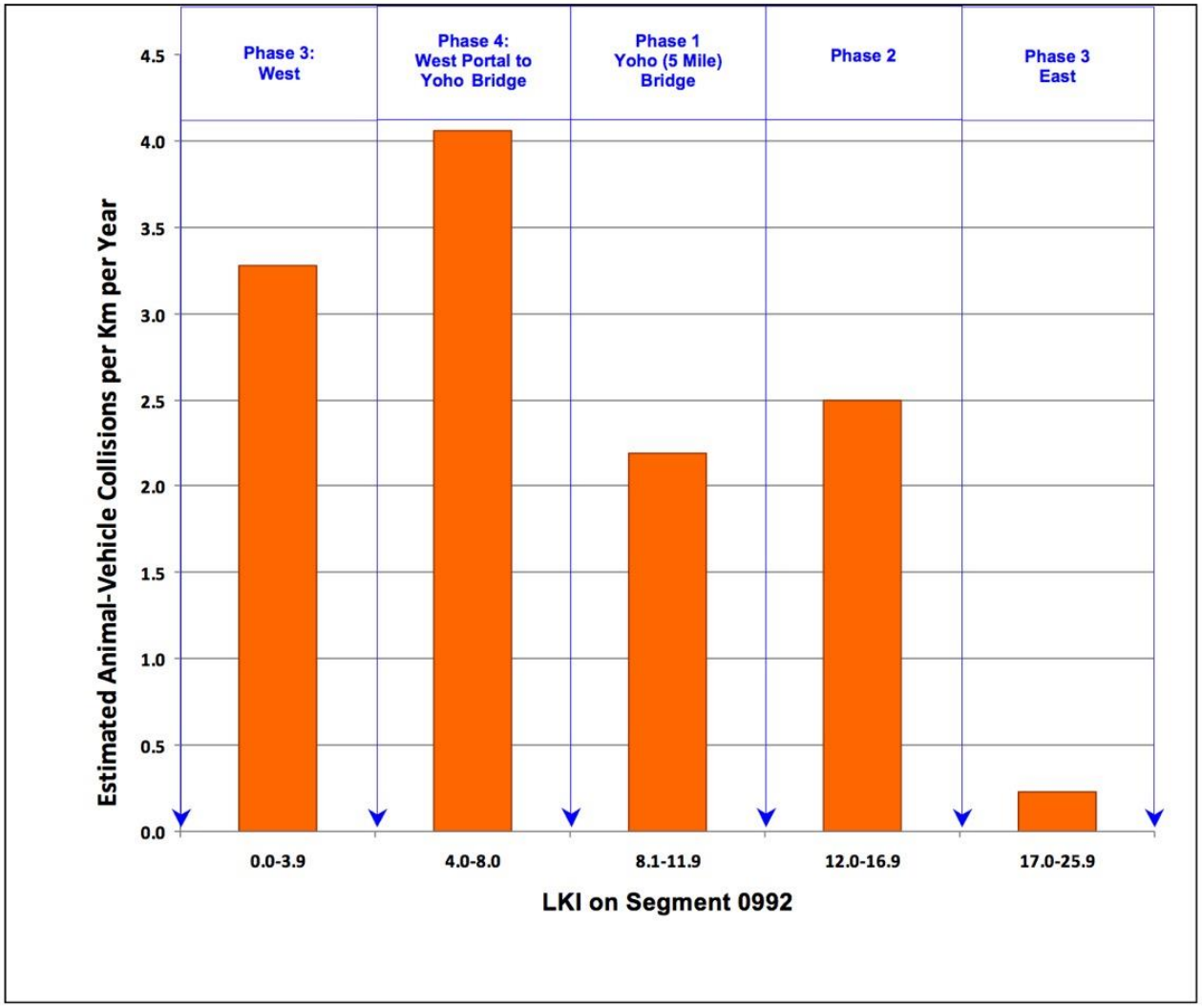
The distribution of animal-vehicle collisions for the period from 2006 to 2013 along the TCH within Phases 1 to 4 of the KHCP was analyzed by the authors in 2016 (Figure 3). The data analysis was based on wildlife accident records in annual reports submitted by the highway maintenance contractor. Similar to the analysis of the 1979 to 2005 data, a five times correction factor was applied to the 2006 to 2013 raw data. The raw data will be entered into the provincial WARS system when it is updated.

Table 6 shows the species composition for the 2016 analysis.

Table 6. Distribution and species involved in animal-vehicle collisions on the Trans-Canada Highway, Kicking Horse Canyon Project (2006-2013 inclusive)

TCH Phase	Estimated Animal-Vehicle Collisions per km per year	Species				Total
		Deer	Elk	Sheep	Other[1]	
3 West	3.3	100%	0%	0%	0%	100%
4	4.1	77%	8%	15%	0%	100%
1	2.2	50%	0%	29%	21%	100%
2	2.5	72%	20%	4%	4%	100%
3 East	0.2	0%	67%	0%	33%	100%

1 Other species include coyote, wolf, fox and bear.
Source: Raw data excerpted from the highway concessionaire annual reports



Source: Raw data excerpted from the highway concessionaire annual reports

Figure 3. Estimated animal-vehicle collisions along the Kicking Horse Canyon portion of the Trans-Canada Highway from 2006 to 2013.

Within the Phase 4 project area for the 8-year period analyzed, the number of animal-vehicle collisions per kilometre per year was about 4, nearly double the number compared to the earlier period analyzed. This increase is likely due to animals end-running the end of the exclusion fencing at the east end of the completed Phase 3 West project. Seventy-seven percent of the animal-vehicle collisions in Phase 4 were deer, 15% were sheep, and 8% were elk.

The 2006 to 2013 data show a decrease in the number of animal-vehicle collisions per kilometre per year for the Phase 3 East and Phase 3 West sections of the project corridor compared to the previous period. In the Phase 3 East segment, which has wildlife exclusion fencing and crossing structures, animal-vehicle collisions declined to near zero. There was also a significant reduction of animal-vehicle collisions in the Phase 3 West project area, which also has wildlife exclusion fencing and one wildlife overpass.

Phases 1 and 2 show an increase in animal-vehicle collisions per kilometre per year from the 1979 to 2005 period, although these two phases still had near the average of animal-vehicle collisions per kilometre per year for the KHCP corridor prior to the highway project improvements. The

increases for both Phase 1 and 2 are likely due to increased traffic volume, higher vehicle speed resulting from improved highway conditions and doubling of width from a two-lane undivided highway to four lanes with shoulders and roadside and median barriers. Also, reporting of animal-vehicle collisions may be more robust now, with required concessionaire reporting and penalties for non-compliance.

It is anticipated that animal-vehicle collisions per kilometre per year in Phase 4 and the KHCP highway corridor will decrease from the current level once the project is completed and the wildlife exclusion fencing system is in place.

5.1.5 Birds and Bird Habitat

Breeding bird surveys near the TCH immediately east of the study area detected 72 species, most of which are widely distributed throughout much of British Columbia (Ferguson 2005). Most of these species were also detected in the Phase 2 project area (Silvatech 2004). These species are widespread and relatively common in suitable habitats throughout the upper Columbia River valley (Ferguson 2004).

5.1.6 Terrestrial Vegetation

The western end of the Kicking Horse Canyon is dominated by young seral forests representing the Kootenay Dry Mild Interior Douglas fir (IDFdm2) biogeoclimatic subzone variant. A survey of terrestrial vegetation was undertaken in 1999, when a limited number of wildlife habitat assessment plots were assessed between Glacier and Yoho National Parks (Chytyk et al. 2000). Wildlife habitat ratings were generated using existing Provincial Vegetation Resources Inventory data of forest cover attributes.

More recently, a description of terrestrial vegetation and wildlife habitat suitability was completed by Timberline Forest Inventory Consultants Ltd. (Ketcheson 2006). Within a project study area 700 metres north and 500 metres south of the existing TCH alignment, terrestrial ecosystems were classified using the Biogeoclimatic Ecosystem Classification (BEC) system. This area included three alignment options to be assessed for their impact on vegetation and wildlife habitat. Maps depicting ecosystems, biodiversity and wildlife habitat were produced at a scale of 1:5,000.

5.1.7 Endangered Species

A search of the B.C. Conservation Data Centre archive in March 2016 did not identify any specific element occurrences (site locations) for animal species at risk, including COSEWIC-listed species, within the project area.

The blue-listed grizzly bear (*Ursus arctos*), wolverine (*Gulo gulo* ssp. *luscus*), bighorn sheep (*Ovis Canadensis*) and western toad (*Anaxyrus boreas*) occur in the project area.

The only rare plants that occur in the general area of the Western Continental Ranges Ecoregion are two red-listed plant species: giant goldenrod (*Solidago gigantea* ssp. *serotina*) and nine-leaved desert parsley *(Lomatium triternatum* ssp. *platycarpum*).

The blue-listed dark lamb's-quarters (*Chenopodium atrovirens*) was last observed near the project area on August 19, 1958. One observation was on mountainside scree of the built-up TCH in the approximate vicinity of Mount Hunter Creek, and the other was on dry roadside on the outskirts of Golden (Conservation Data Centre 2004).

The blue-listed Crawe's sedge (*Carex crawei*) occurs near the town of Golden and along the TCH near Edelweiss. Two yellow-listed plant species are also known to occur in the general area: Smith's melic (*Melica smithii*) and Bourgeau's milk-vetch (*Astragalus bourgovii*).

None of these plant species were observed during rare-plant surveys along the existing highway alignment in 2000 (Cooper et al. 2000).

A rare plant survey for the Phase 3 West project in 2009 identified the red-listed limber pine (*Pinus flexilis*) in the project area near LKI 5 (Focus 2009). The B.C. Conservation Centre archive identifies specific element occurrences (site locations) of the limber pine near the current TCH corridor within Phase 4 in smaller numbers near the western end of the project area and in a larger area near Yoho Bridge.

Prior to construction the endangered species list for the project area will be reviewed and updated and specific locations flagged if close to the project footprint.

5.1.8 Historical, Archaeological, Paleontological or Architectural

Archaeological studies were conducted by Wayne Choquette and Points West Heritage Consulting Ltd. along the existing TCH in the project area during 1997 to 2001 (Choquette 1997; Points West 2000a, 2000b, 2001). An important site (EhQf-6), comprised of stone tools, lithic debitage and a cairn, was identified in the Dart Creek drainage. A trail noted in the Blackwall Bluffs area may also be associated with the archaeology site.

Archaeology overview assessments, which included preliminary field reconnaissance, for the project were also undertaken in 2006, with assistance from the Ktunaxa Nation and the Shuswap Nation Tribal Council. An archaeological impact assessment was undertaken for this site in the fall of 2006. This assessment delineated the extent of the EhQf-6 site relative to the project area and provided a survey of the site boundaries.

Further archaeological investigations were undertaken between 2007 and 2011. The results of these studies were presented and recommendations discussed (Golder 2014).

5.2 Expected Environmental Impacts and Severity Rankings

The expected environmental impacts of the construction and operation of the Phase 4 project are summarized by the environmental components below. Severity rankings are provided below and summarized in Table 7. Proposed mitigation measures, post-construction monitoring requirements, and public and stakeholder concerns are also discussed.

5.2.1 Groundwater

There are no water wells within or potentially affected by the project.

Impact severity: low

5.2.2 Surface Water

The Phase 4 highway alignment will not cross the Kicking Horse River, and no work is proposed within the wetted perimeter of the Kicking Horse River. Several small, ephemeral non-fish-bearing tributaries, including Dart Creek, will be crossed.

Surface water quality can be effectively protected by applying standard construction procedures, as described in Section 165, Protection of the Environment, of MoTI's *Standard Specifications for Highway Construction* (MoTI 2012), including preparation and adherence to sediment and

drainage management plans reviewed and approved by MoTI and the relevant provincial regulatory agencies.

There are two registered water licences on Dart Creek, one of which expires in 2017, held by two local area property owners. Local residents also use Dart Creek as a supplementary potable water source. An elevated pipe located on the north side of the TCH is used to capture water coming out of the ground in the area and fill water tanks hauled in vehicles. Site access and excavation required for highway widening as well as the hydrogeology in the area should be considered in the design.

Surface water impacts are unlikely to require follow-up programs or to cause concern for stakeholders or the public if appropriate mitigation measures are implemented.

Impact severity: low

5.2.3 Potential ML/ARD

There is potential for acid rock drainage from the Glenogle rock formation on the east side of Dart Creek. However, mitigation to offset potential impacts is available and will be implemented as required.

A possible technique would be to create separate disposal stockpiles in the Dart Creek Valley for Glenogle and McKay units and then encapsulate the potential ML/ARD material by placement of a thick cap of McKay material over the Glenogle material. Till and topsoil would then be spread over the entire stockpile. Consideration will have to be given to surface infiltration of leachate into the groundwater and also to surface runoff (Rescan 2008).

Pre-planning investigations indicate that there are adequate storage and treatment areas in the Dart Creek Valley without impacting archaeological sites or areas with high archaeology potential rating (D. Grykuliak pers. comm).

A preliminary engineering design will be prepared for disposal of surplus material as the project proceeds.

Impact severity: low

5.2.4 Fish and Fish Habitat

The project design will not require any disturbance within the 200-year floodplain of the Kicking Horse River, and riparian vegetation loss will be minimized. There are no fish-bearing streams crossed by the new highway alignment.

Application of standard sediment and drainage management procedures (MoTI 2012) will protect fish habitat and water quality downstream from the highway during construction. Therefore, no adverse effects on fish or fish habitat are anticipated.

Fish and fish habitat impacts are unlikely to require follow-up programs or to cause concern for stakeholders or the public.

Impact severity: low

5.2.5 Terrestrial Wildlife and Wildlife Habitat

The area that will be affected by the project provides habitat for several large mammal species. Habitat of this type is locally and regionally common, and habitat loss is not likely to result in populations being reduced beyond normally observed variation.

Oversized drainage culverts with accessible inlets and outlets and concrete roadside barriers with large-size scuppers are recommended to address small animal passage concerns, and the bridge designs will facilitate large animal passage.

With appropriate mitigation measures in place, it is unlikely that there will be measurable negative impacts on wildlife populations associated with direct mortality from animal-vehicle collisions, habitat fragmentation from barriers to animal movement, direct loss of habitats to the project footprint or cumulative effects associated with other wildlife impacts in the area.

Even though the more detailed analysis of data from 1979 to 2005 and 2006 to 2013 shows that the rate of animal-vehicle collisions declines from west to east and is relatively low near Yoho (Five Mile) Bridge (Figure 2), the highway design in this area is very constricting, with all the design options making use of bridges and retaining walls to varying degrees. This means that large animals that encounter the highway stand an increased chance of becoming trapped on the paved surface, either above a retaining wall or on a bridge. For this reason, Harper (2007b) recommended that wildlife exclusion fencing be installed on both sides of the highway throughout the Phase 4 project area.

Terrestrial wildlife and wildlife habitat impacts are unlikely to require follow-up programs or to cause concern for stakeholders or the public. There will be continued monitoring of animal-vehicle collisions.

Impacts to aquatic wildlife species and aquatic habitats associated with non–point source highway run-off pollution are not considered significant and should be adequately addressed through provincial water quality standards and MoTI highway construction standards.

Impact severity: low

5.2.6 Birds and Bird Habitat

No rare birds are known to rely on the project area for their survival. Bird surveys in 2005 did not detect any red- or blue-listed bird species (Ferguson 2005). Several common bird species likely nest in trees in the project area (Ferguson 2005). To avoid disturbing nesting birds, trees and understorey vegetation will be not be cleared between April 1 and July 31, when active bird breeding and nesting are likely to occur, unless pre-clearing nesting surveys conducted by a qualified environmental professional confirm that these activities are not occurring. Blasting will also be avoided in the vicinity of any sensitive species' nests — raptors, for example — during this period.

Impacts to birds and bird habitats are unlikely to require follow-up programs or to cause concern for stakeholders or the public.

Impact severity: low

5.2.7 Terrestrial Vegetation

Mature and old forest stands are rare in the project area, especially where they support red- and blue-listed ecosystems. For the most part, the vegetation that will be lost is locally and regionally common (Ketcheson 2006). An exception is the mature successional stage (class 6 and 7) of the Douglas fir/snowberry/balsamroot community that is red-listed by the B.C. Conservation Data Centre (Ketcheson 2006). This rare plant community was located above Blackwall Bluffs in the Dart Creek drainage just north of the existing alignment of the Trans-Canada Highway (mapped by Ketcheson 2006 and confirmed in the field in 2007).

Through available design strategies, efforts will be made to avoid or minimize disturbance of this rare plant community to the greatest extent possible given the topographic constraints. Areas where vegetation removal will be undertaken will be minimized.

Clearing will be minimized to accommodate construction of the cut/fill limits established during detailed design and within the limits of the maps in Appendix 1.

The project is expected to produce surplus excavated material. The total volume of surplus material will be determined as the project detailed design proceeds. Several options are available to temporarily or permanently store or use the material. Stockpiling the material would require use of recently clearcut forest land. Where possible, the stockpile would be topped with soil and revegetated.

Terrestrial vegetation impacts are unlikely to require follow-up programs or to cause concern for stakeholders or the public.

Impact severity: moderate

5.2.8 Endangered Plants and Animals

Surveys in 2000 did not detect any rare plant species along the existing alignment (Cooper et al. 2000). However, as previously noted, the blue-listed dark lamb's-quarters was last observed near the project area in 1958.

The B.C. Conservation Data Centre records show that the red-listed limber pine occurs in the Phase 4 project area. Also, a rare plant survey done for the Phase 3 West project reported the limber pine near LKI 5, and Harper reported sighting (unconfirmed) limber pine in the Phase 4 project area near LKI 5 (Focus 2009; Harper 2011). Potential identified sites are shown in the figures in Appendix 1.

There are two small areas at the western end of the project near the south boundary of the project area, and the limber pines areas shown can likely be avoided. There is one large area near the eastern end of the project where there are potential limber pines. In this area the project is only widening the existing highway from three lanes to four lanes. North of the highway there is expected to be little ground disturbance, and south of the existing highway the widening is expected to be largely in ground already disturbed and it is unlikely there will be limber pines in this narrow area next to the existing highway.

Limber pine locations need to be further assessed and verified. Avoidance of these trees is preferred, if feasible. If any are found to be within the project footprint that cannot be avoided, then mitigation should be considered.

Although the likelihood of other endangered plants occurring within the project area is considered low, efforts will be made prior to and during construction to look for their presence in appropriate habitat types in order to prevent any possible negative impacts.

The only animal species at risk that might be affected by highway construction are the blue-listed grizzly bear, wolverine, bighorn sheep and western toad. However, significant negative impacts are not anticipated if appropriate mitigation strategies are employed.

Of these species, bighorn sheep are the most likely to be affected because the resident population has a home range on both sides of the highway. Grizzly bears and wolverines are the only other rare species likely to pass through the project area from time to time, but they are not likely to be adversely affected with the planned wildlife exclusion fencing mitigation system.

Western toads may occur in the area because they are widespread and locally abundant throughout most of their Canadian range. However, the project area is generally steep and relatively dry, which is not preferred habitat for this species. As well as being blue-listed in the B.C. classification system and a COSEWIC species of special concern, the western toad is listed under part 4 of schedule 1 of the federal Species at Risk Act as a species of special concern. This is the lowest level of risk among the categories of species at risk and reflects concern over declines of western toad populations further south, in the United States.

Impacts to endangered plants and animals are unlikely to require follow-up programs or to cause concern for stakeholders or the public.

Impact severity: low

5.2.9 Navigation

The alignment does not cross the Kicking Horse River. Therefore, there is no impact to navigation.

Impact severity: nil

5.2.10 Recreation

Local residents, tourism groups, river-rafting groups, hikers and kayakers use the Kicking Horse River for whitewater adventures and viewing. Rafters and kayakers access the river by way of the CP Rail road west of the Yoho Bridge. Local residents also use the Dart Creek drainage area for recreational purposes. Access to rafter put-in areas on the Kicking Horse River, the Dart Creek drainage area and potential viewing areas in the canyon will be considered.

Tourists and recreational resource users will benefit from improved access and highway safety.

Impact severity: beneficial

5.2.11 First Nations Traditional Use

The project is within the Ktunaxa Nation, Adams Lake Indian Band, Neskonlith Indian Band, Shuswap Indian Band and Splatsin Indian Band territory. These groups have been and will continue to be consulted throughout the project schedule. A formal consultation process has been initiated with these groups and will continue as the project develops.

Impact severity: to be confirmed following further consultation with First Nations

5.2.12 Historical, Archaeological, Paleontological or Architectural

Important precontact archaeological sites have been identified near the project area. These sites range from localized lithic scatters to a large, extensive stone tool–manufacturing site in the Dart Creek drainage area. Also, trails in the Blackwall Bluffs area may be associated with this site (Golder 2006, 2014).

The project design currently avoids disturbing any of the sites or areas of high archaeology potential. However, if it is determined that disturbance to a site is unavoidable, then a site alteration permit and approved mitigation will be required. Mitigation in the form of a recovery and monitoring program will likely be a condition of the permit.

Appropriate mitigative measures will be implemented if archaeological resource impacts cannot be avoided.

Impact severity: low

5.2.13 Noise

The project, located in the canyon, is remote, with no adjacent habitation affected by noise from the new highway.

Impact severity: nil

5.2.14 Air Quality

Increased speed is expected to increase fuel consumption, resulting in a slight increase in greenhouse gas (GHG) emissions using current vehicle technology and fuels. However, the federal government's plan to reduce Canada's GHG emissions will mitigate this potential increase. If the government's plan is effective, GHG emissions associated with this section of the highway will remain the same or be less than the emissions that would have been produced had the project not been completed and the government plan not implemented.

During construction MoTI will require the contractor to implement an anti-idling policy on the project to reduce GHG emissions.

Impact severity: nil

Table 7. Potential project impacts

Environmental Element	Potentially Adversely Affected?	Are Effective Mitigation Measures Available?	Impact Severity
Groundwater	Yes	Yes. Impacts can be avoided by design. See Potential ML/ARD below.	Low
Surface water	Yes	Yes. Standard sediment and drainage management measures will mitigate. See Potential ML/ARD below.	Low
Potential ML/ARD	Yes	There is potential for acid rock drainage from the Glenogle rock formation on the east side of Dart Creek. Mitigation to offset potential impacts to surface and groundwater is available and will be implemented as required.	Low
Aquatic vegetation	No		Nil
Wetlands	No		Nil
Fish and fish habitat	Yes	Yes. Impacts can be avoided by design and application of standard sediment and drainage management measures.	Low
Terrestrial wildlife and wildlife habitat	Yes	Yes. Standard mitigation should be adequate. Special measures are available – i.e., wildlife exclusion fencing systems	Low
Birds and bird habitat	Yes	Yes. Restrictions on clearing during nesting season, April 1 to July 31.	Low
Terrestrial vegetation	Yes	Yes. Most of the vegetation that will be cleared is common. Disturbed areas will be revegetated. Efforts will be made to avoid or minimize disturbance of rare plant community, and vegetation removal areas will be minimized. Clearing will be minimized to accommodate construction of the cut/fill limits established during detailed design and within mapped limits.	Moderate
Endangered plants and animals	Yes	Yes. There is the remote possibility that the red-listed plant dark lamb's-quarters could be found on dry scree habitats associated with the existing highway. Limber pine more likely to be found in project area. Mitigation measures are available should these species be encountered.	Low
Navigation	No	Impact avoided. No bridge crossing is planned over the Kicking Horse River.	Nil
Recreation	No	Public access and safety will be improved.	Beneficial
Human health	No		Nil
Socioeconomic conditions	No		Nil
Physical/cultural heritage	No		Nil
First Nations traditional use	No	Mitigation is available should consultation identify traditional use.	To be confirmed following consultation with First Nations
Historical, archaeological, paleontological or architectural	Yes	Yes. Mitigation measures are available if archaeological resource impacts cannot be avoided.	Low
Noise	No	Remote canyon location with no adjacent habitation affected by noise issues.	Nil
Air quality	No	Federal government plans to reduce vehicle emissions should mitigate potential increased GHG production. Anti-idling policy will be required.	Nil

6.0 Conclusions

The Phase 4 Project is unlikely to result in environmental impacts that cannot be effectively mitigated by following standard MoTI policies and procedures for highway design and environmental protection and application of recommended environmental mitigation measures in compliance with required environmental protection planning documents prepared specifically for this project.

Residual impacts are expected to be acceptable to the public, stakeholders and regulatory agencies. Public, stakeholder and agency consultation to date has not identified any issues that cannot be resolved through design, planning and ongoing consultation.

7.0 Recommendations

The following tasks are recommended prior to detailed design and construction of the project:

- A further ML/ARD study should be undertaken for the proposed surplus material storage sites at Dart Creek to determine the storage area required and appropriate mitigation requirements for treatment of material.
- The recommended preliminary design wildlife exclusion system should be reviewed by a qualified wildlife biologist before procurement.
- A review of the endangered species and ecosystems lists for the project area should be undertaken and the lists updated if required.
- A rare plant survey should be undertaken that includes reporting the locations of the limber pine species discussed in sections 5.1.7 and 5.2.8. If any rare plants, including limber pine, are found within the project footprint and cannot be avoided, a mitigation plan should be developed and included in the final design.
- Ongoing further consultation with First Nations.

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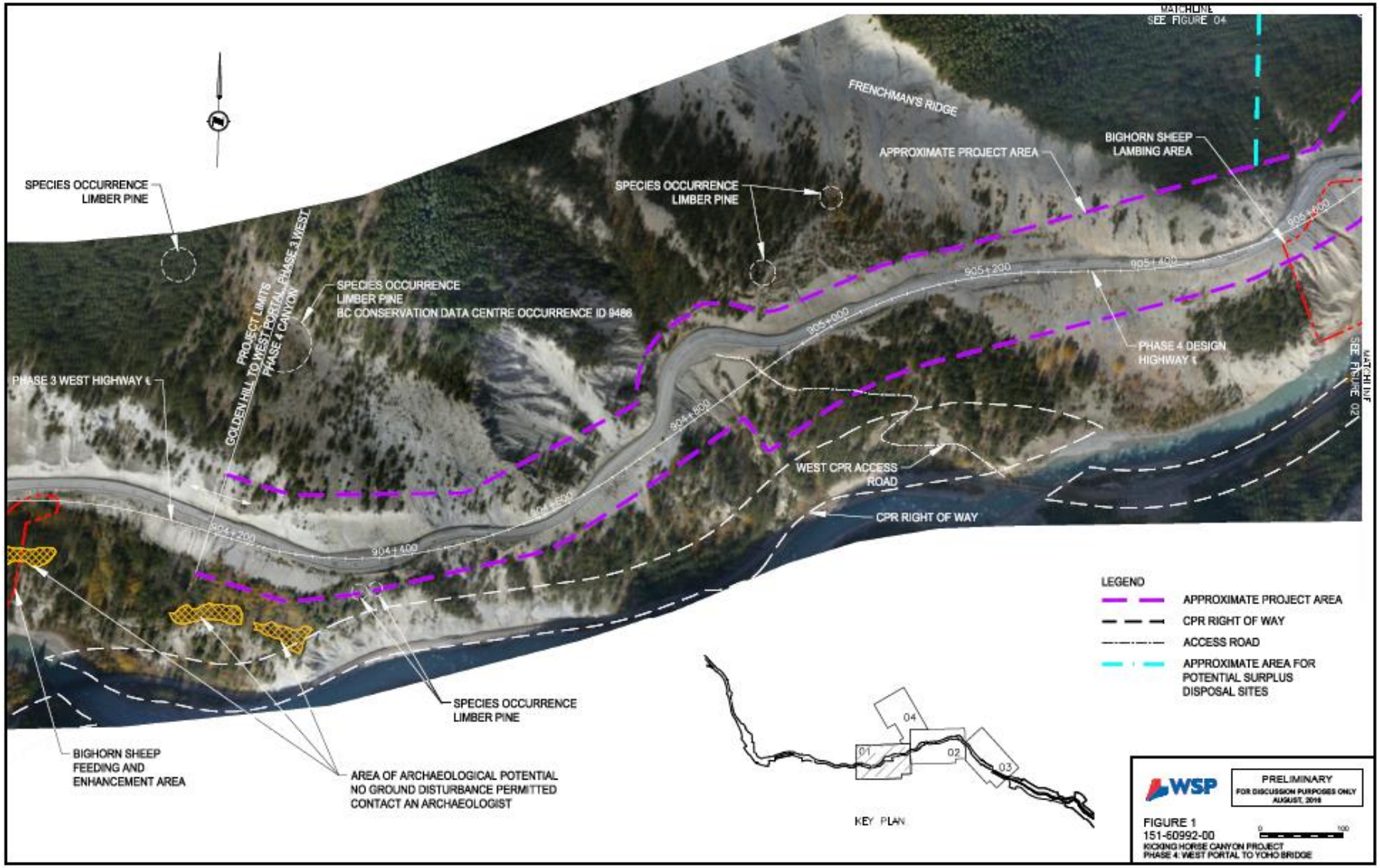
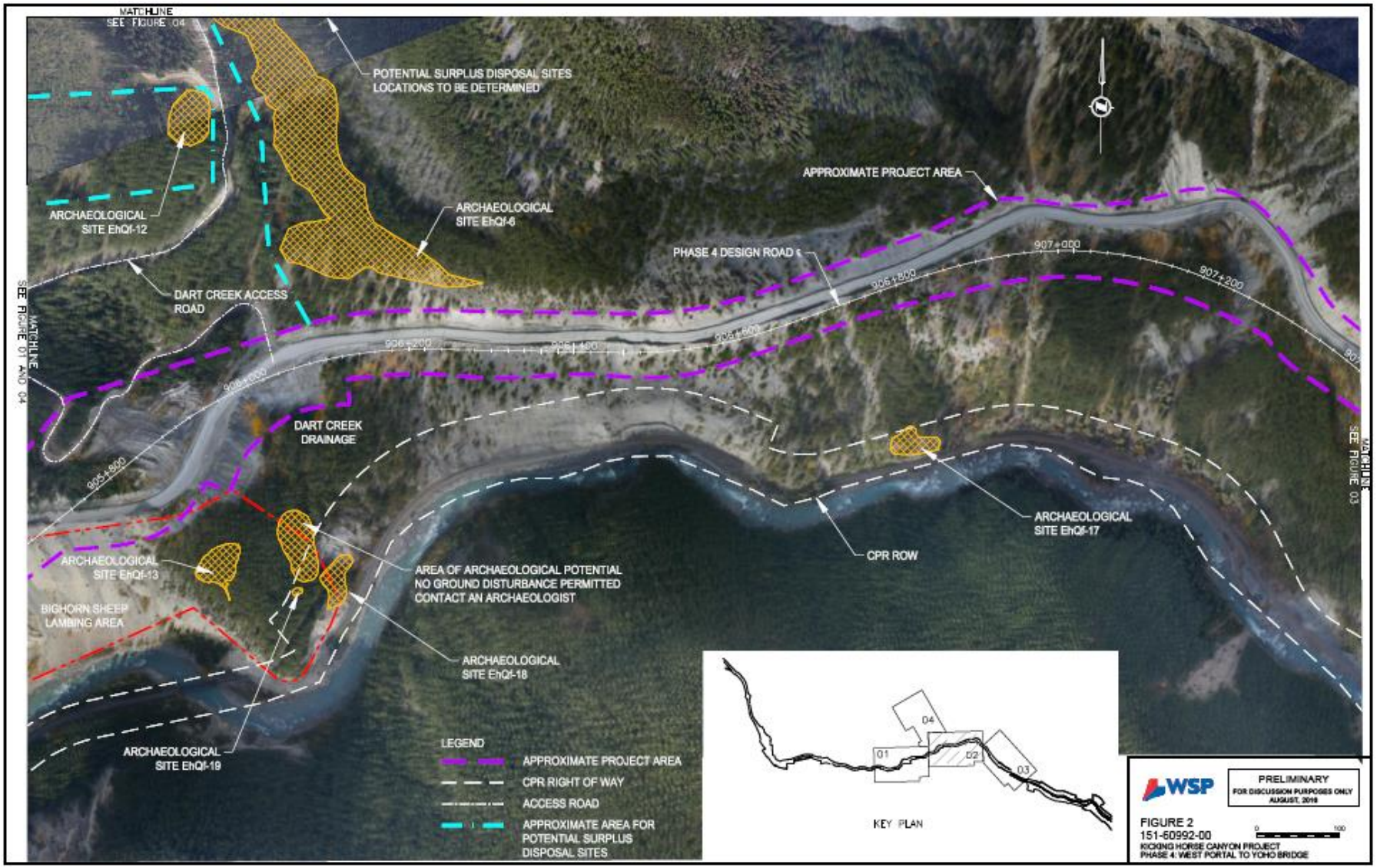
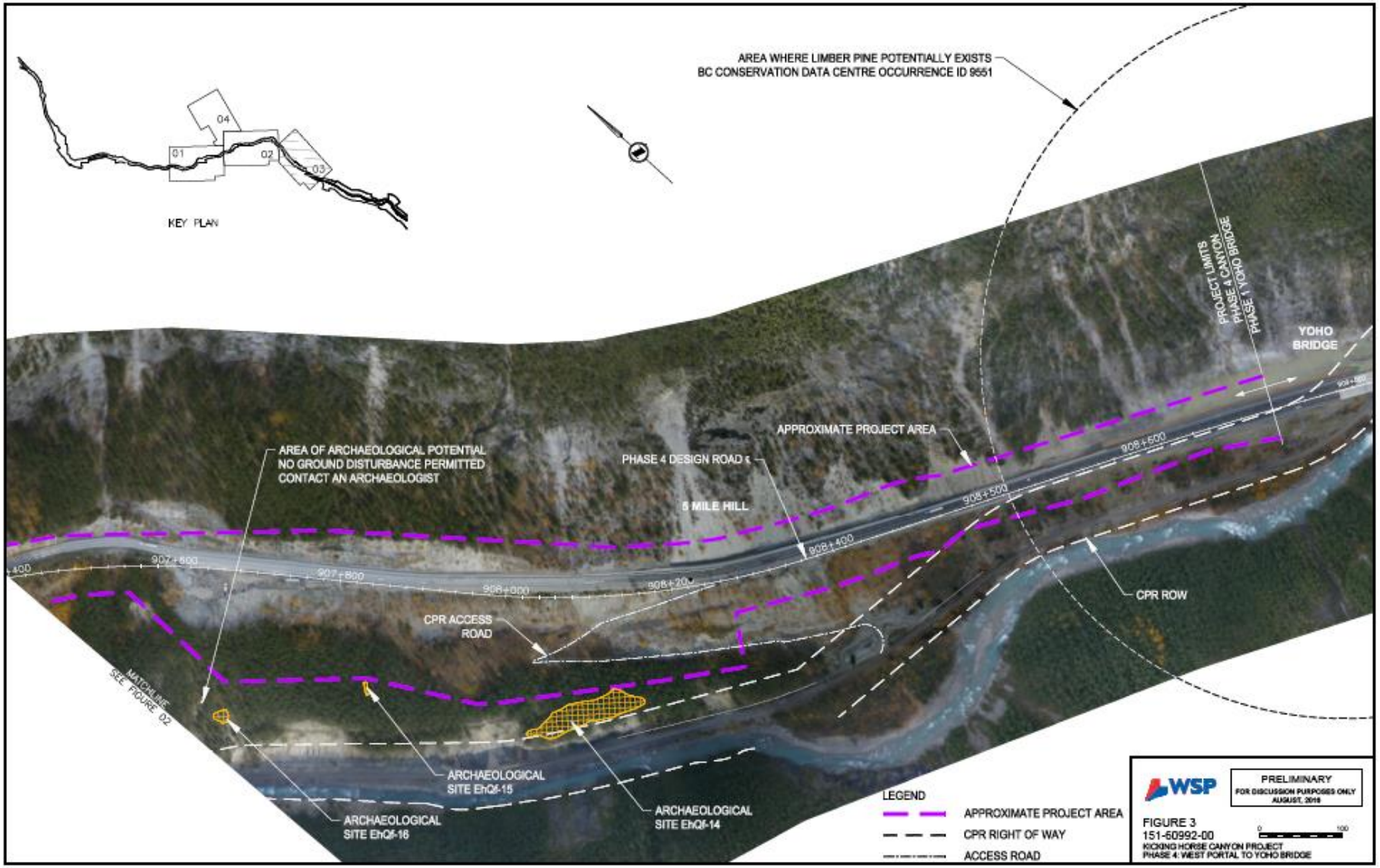
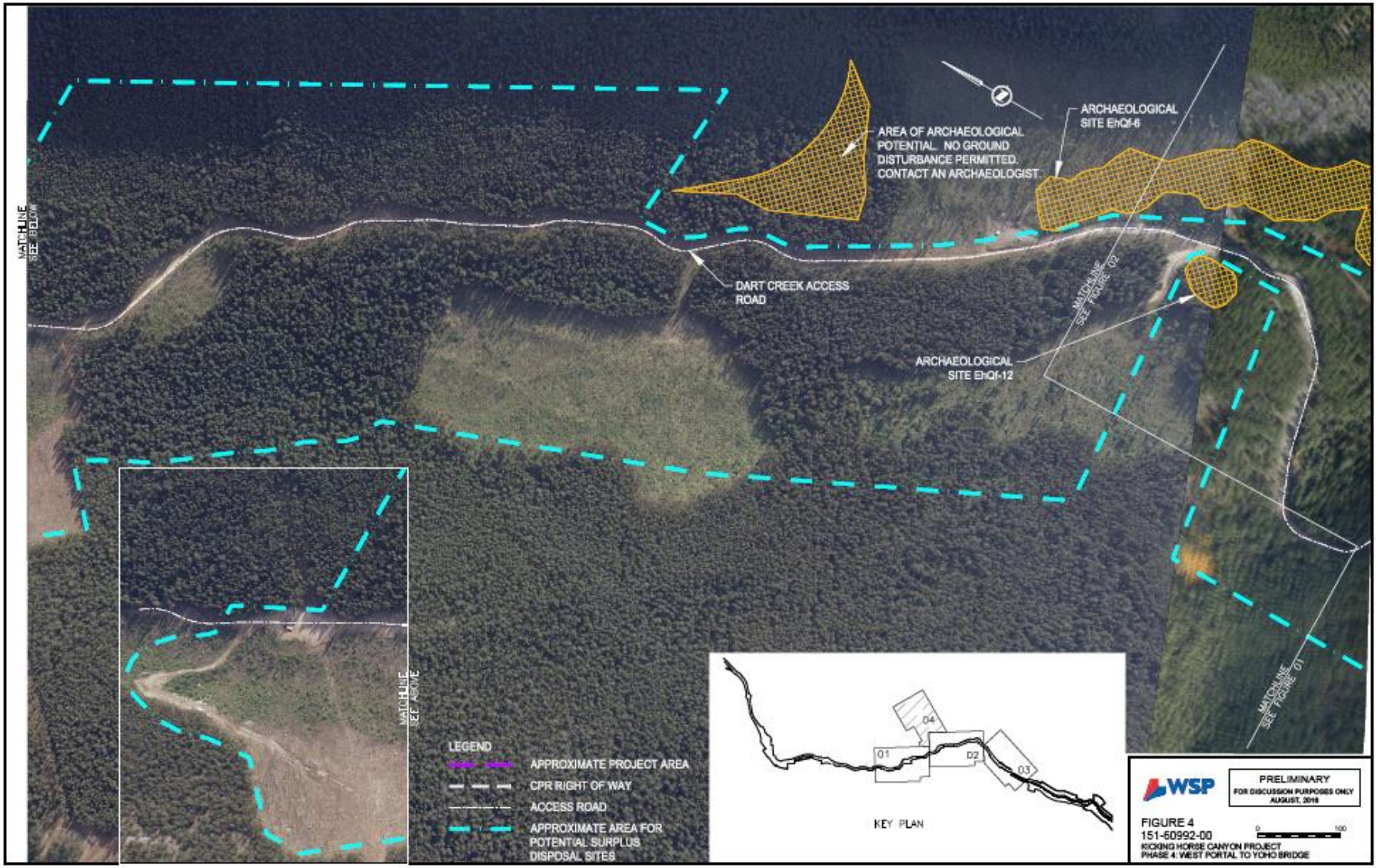
Appendix 1. Phase 4 Environmental Drawings


MATCHLINE
SEE FIGURE 04
FRENCHMAN'S RIDGE
APPROXIMATE PROJECT AREA
BIGHORN SHEEP
LAMBING AREA
SPECIES OCCURRENCE
LIMBER PINE
SPECIES OCCURRENCE
LIMBER PINE
PROJECT LIMITS
GOLDEN HILL TO WEST PORTAL PHASE 3 WEST
PHASE 4 CANYON
SPECIES OCCURRENCE
LIMBER PINE
BC CONSERVATION DATA CENTRE OCCURRENCE ID 9486
905+200
905+400
905+600
906+000
PHASE 4 DESIGN
HIGHWAY
PHASE 3 WEST HIGHWAY
904+800
904+600
904+400
904+200
WEST CPR ACCESS
ROAD
CPR RIGHT OF WAY
MATCHLINE
SEE FIGURE 02
LEGEND
APPROXIMATE PROJECT AREA
CPR RIGHT OF WAY
ACCESS ROAD
APPROXIMATE AREA FOR
POTENTIAL SURPLUS
DISPOSAL SITES
SPECIES OCCURRENCE
LIMBER PINE
BIGHORN SHEEP
FEEDING AND
ENHANCEMENT AREA
AREA OF ARCHAEOLOGICAL POTENTIAL
NO GROUND DISTURBANCE PERMITTED
CONTACT AN ARCHAEOLOGIST
04
01
02
03
KEY PLAN
WSP
PRELIMINARY
FOR DISCUSSION PURPOSES ONLY
AUGUST, 2016
FIGURE 1
151-50992-00
KICKING HORSE CANYON PROJECT
PHASE 4: WEST PORTAL TO YOHO BRIDGE


MATCHLINE
SEE FIGURE 04
POTENTIAL SURPLUS DISPOSAL SITES
LOCATIONS TO BE DETERMINED
APPROXIMATE PROJECT AREA
ARCHAEOLOGICAL
SITE EhQf-12
ARCHAEOLOGICAL
SITE EhQf-6
PHASE 4 DESIGN ROAD
DART CREEK ACCESS
ROAD
907+000
906+800
907+200
906+200
906+400
906+000
905+800
905+600
DART CREEK
DRAINAGE
MATCHLINE
SEE FIGURE 01 AND 04
MATCHLINE
SEE FIGURE 03
ARCHAEOLOGICAL
SITE EhQf-17
CPR ROW
ARCHAEOLOGICAL
SITE EhQf-13
AREA OF ARCHAEOLOGICAL POTENTIAL
NO GROUND DISTURBANCE PERMITTED
CONTACT AN ARCHAEOLOGIST
BIGHORN SHEEP
LAMBING AREA
ARCHAEOLOGICAL
SITE EhQf-18
ARCHAEOLOGICAL
SITE EhQf-19
LEGEND
APPROXIMATE PROJECT AREA
CPR RIGHT OF WAY
ACCESS ROAD
APPROXIMATE AREA FOR
POTENTIAL SURPLUS
DISPOSAL SITES
01
02
03
04
KEY PLAN
WSP
PRELIMINARY
FOR DISCUSSION PURPOSES ONLY
AUGUST, 2016
FIGURE 2
151-60992-00
KICKING HORSE CANYON PROJECT
PHASE 4: WEST PORTAL TO YOHO BRIDGE


AREA WHERE LIMBER PINE POTENTIALLY EXISTS
BC CONSERVATION DATA CENTRE OCCURRENCE ID 9551
KEY PLAN
04
01
02
03
PROJECT LIMITS
PHASE 4 CANYON
PHASE 1 YOHO BRIDGE
YOHO BRIDGE
APPROXIMATE PROJECT AREA
AREA OF ARCHAEOLOGICAL POTENTIAL
NO GROUND DISTURBANCE PERMITTED
CONTACT AN ARCHAEOLOGIST
PHASE 4 DESIGN ROAD
5 MILE HILL
908+500
908+400
907+800
908+000
908+200
CPR ROW
CPR ACCESS ROAD
MATCHLINE SEE FIGURE 02
ARCHAEOLOGICAL SITE EhQf-15
ARCHAEOLOGICAL SITE EhQf-16
ARCHAEOLOGICAL SITE EhQf-14
LEGEND
APPROXIMATE PROJECT AREA
CPR RIGHT OF WAY
ACCESS ROAD
WSP
PRELIMINARY
FOR DISCUSSION PURPOSES ONLY
AUGUST, 2016
FIGURE 3
151-50992-00
KICKING HORSE CANYON PROJECT
PHASE 4: WEST PORTAL TO YOHO BRIDGE


AREA OF ARCHAEOLOGICAL POTENTIAL. NO GROUND DISTURBANCE PERMITTED. CONTACT AN ARCHAEOLOGIST.
ARCHAEOLOGICAL SITE EhQl-6
DART CREEK ACCESS ROAD
ARCHAEOLOGICAL SITE EhQl-12
MATCHLINE SEE BELOW
MATCHLINE SEE FIGURE 02
MATCHLINE SEE FIGURE 01
MATCHLINE SEE ABOVE
LEGEND
APPROXIMATE PROJECT AREA
CPR RIGHT OF WAY
ACCESS ROAD
APPROXIMATE AREA FOR POTENTIAL SURPLUS DISPOSAL SITES
01
02
03
04
KEY PLAN
WSP
PRELIMINARY
FOR DISCUSSION PURPOSES ONLY
AUGUST, 2016
FIGURE 4
151-60992-00
KICKING HORSE CANYON PROJECT
PHASE 4: WEST PORTAL TO YOHO BRIDGE

Appendix 2. Site-Specific Summary of Environmental Features and Sensitivity Rating in LKI Segment 0992.

LKI (Offset km)	Feature Description	Fish Habitat Rating	MoTI Sensitivity Rating	Fish Species	Proposed Mitigation	Comments
4.75	Culvert, 600 mm CSP, 4.75 km east of junction of Route 95 and Route 1 Golden	Nil	Low	None	Maintain downstream water quality and quantity	• Undefined channel/drainage area. • Seasonal flow observed. • Erosion scars observed south of highway. • Gradient >30% north and south of highway.
5.80 to 6.10	Bighorn sheep lambing area	N/A	High	N/A	Avoid encroachment or disturbance during lambing period.	• Lambing area is between TCH and Kicking Horse River.
6.23	Dart Creek. Culverts, two 600 mm CSP	Nil	Low	None	Maintain downstream water quality and quantity. Maintain recreational access. Maintain access to water source on north side of TCH. Avoid archaeological impact	• 1-2 m wide stream channel with moderate flow observed. • Gradient >40% north and south of highway. • 100 m downstream may be accessible to fish and likely provides high water mainstem refuge. • Significant erosion scars observed south of highway. • Prefer highway expansion to north to avoid encroaching into Kicking Horse River. • Important archaeological site.
0.00 to 9.45	6-600 mm CSP, 1-900 mm CSP, 1-1800 mm CSP	Nil	Low	None	Maintain downstream water quality and quantity.	• Culverts require field inspection to verify habitat and sensitivity ratings.
0.00 to 9.45	Kicking Horse River	Low	Moderate	See section 5.1.2	No encroachment onto 200-year floodplain. Minimize riparian vegetation loss. Maintain water quality.	• Provides spawning and rearing habitat for salmonids and other fish species. • Fish habitat quality and production is limited by seasonal high turbidity, low water temperature and low nutrient level. • Tributary confluence areas provide important fish habitat and refuge areas during high flows.