Executive Summary

Detailed Impact Analysis

Trans-Canada Highway Twinning– Phase IVB, Yoho National Park

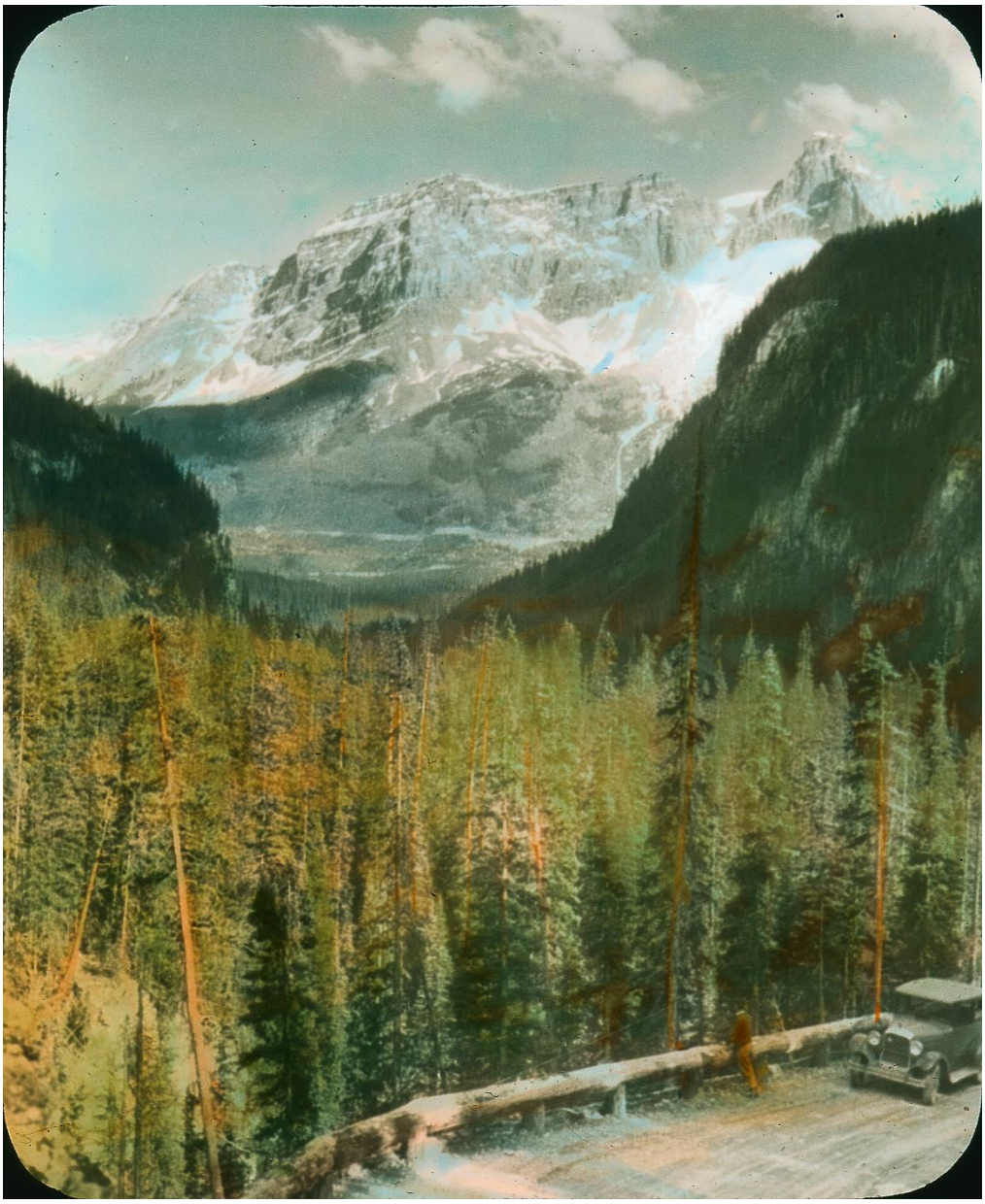

Photo caption/credit: Looking up the Yoho Valley at Spiral Tunnels Viewpoint*, c.* 1930. (McCord Museum, MP-0000.25.652)

Executive Summary

Project Overview

Parks Canada Agency (PCA) is proposing to twin a 40 km portion of the Trans-Canada Highway (TCH) from the end of the existing 4-lane section near Sherbrooke Creek to the western border of Yoho National Park (YNP) (the Project). The TCH in this location is currently unfenced and designed as a two-lane rural arterial undivided highway. Once completed, the Project will operate as a four-lane rural arterial divided highway separated by a grassed median or a raised concrete barrier. The additional lanes will overlap or be immediately adjacent to the current TCH alignment. Twinning of the TCH is needed to upgrade the capacity and safety of the roadway to accommodate increased traffic, while also maintaining and restoring ecological integrity in the park.

The TCH is Canada's main east-west transportation corridor, serving as the most important commercial trade corridor between western Canada and the rest of the country. The TCH is also a major route facilitating the use of the mountain parks with around 5 million visitors each year. A portion of the TCH, Highway 1 runs for 82 km through Banff National Park (BNP) before entering YNP, through which it runs a further 46 km. Annual average daily traffic volumes entering YNP reaches approximately 7,500 vehicles per day, with summer average daily traffic volumes of approximately 14,500 vehicles per day.

Phase IVA of the YNP twinning project, which covers the 6 km west of the Alberta/British Columbia border, was completed in the fall of 2018. The subject of this Detailed Impact Analysis (DIA), Phase IVB, covers the remaining 40 km from KP 88+000 to KP 127+500. This DIA assesses the Project's potential effects, identifies mitigations aimed at reducing or eliminating adverse effects, and determines the residual effects of the Project on Valued Components (VCs) which are key ecological and cultural resources that are characteristic of the environment, unique or outstanding features, and/or important to main visitor experience objectives.

PCA is responsible for managing the land and the resources within national parks. That responsibility includes the management and protection of natural and cultural resources and the promotion of environmental stewardship. *Parks Canada's Directive on Impact Assessment* stipulates that the DIA process is applied to any proposed project with potential significant adverse effects and/or public concern with respect to ecological integrity, the integrity of cultural resources or characteristics of the environment that are important to key visitor experience objectives. The Project has the potential for significant environmental effects and may generate significant public interest. For these reasons, the project is subject to a DIA.

Parks Canada is accountable under several pieces of legislation and policies for identifying and managing the potential environmental effects of proposed projects, policies, programs and plans for which it has decision–making authority. Parks Canada applies the EIA process when making a determination of significance under the *Canadian Environmental Assessment Act* for proposed projects within a protected heritage place administered by Parks Canada. On 28 August 2019, Bill C-69 came into effect enacting the *Impact Assessment Act* which supersedes the *Canadian Environmental Act* and amends the *Navigation Protection Act.* As the DIA for the Project was already in progress, it will continue to be assessed under the *Canadian Environmental Act*.

The assessment approach used in this DIA considers how to minimize the Project effects to VC by utilizing an iterative process between Environment and initial engineering planning and design. The initial planning and design process identified sensitive cultural and environmental features, geotechnical hazards and engineering challenges, then applied key environmental mitigation approaches of avoidance and footprint minimization, with the objective of developing an alignment that maximizes visitor safety while minimizing environmental effects. The final Project detailed design, including fine scale level of detail in location and extent of the Project footprint, will be completed in stages as construction funding becomes available.

Project Rationale

The Project has been proposed to meet key strategies and outcomes identified by PCA in the *Yoho National Park Management Plan*. The main goals of the Project are to:

- upgrade the capacity and safety of the roadway to accommodate increased traffic;
- bring about environmental improvements and resolve wildlife and traffic conflicts to maximize motorist safety; and
- improve the reliability of movement through this corridor which is achieved by facilitating safety and minimizing delays that can lengthen travel times.

Parks Canada is recognized as a world leader in highway-related environmental protection measures and highway mitigation research. The Project will continue to set a high standard for environmental mitigation measures such as wildlife exclusion fencing, underpasses and overpasses to facilitate crossings by different species and maintain connectivity along major wildlife corridors.

Detailed Impact Analysis Objectives

The purpose of the DIA is to determine the Project effects on selected valued natural and cultural resources in proximity to the Project. The DIA is designed to meet the following objectives:

- Assess effects of the Project on the local environment and determine if the Project is likely to cause adverse environmental effects (including changes to the natural or human environment) in relation to PCA's mandated responsibilities.
- Identify suitable mitigation measures to reduce or remove these potential effects.
- Summarize any residual adverse effects that remain following the implementation of mitigation measures and provide an analysis of cumulative effects.
- Identify suitable follow-up monitoring programs and Environmental Management Plans (EMPs), as necessary.

The conclusions of the DIA are intended to provide adequate detail for the Field Unit Superintendent to determine the likelihood of the Project to cause significant adverse environmental effects.

The analysis is also used by PCA and their consultants to inform the detailed design and location of the proposed twinning Project. Consultation with Indigenous groups, the public and stakeholders, will inform

both the DIA and overall development of the Project. Consultation on the Project commenced in the spring of 2017 and will continue for the foreseeable future.

Regulatory Context and Policy Framework

Parks Canada's decisions about the acceptability of Projects are guided by a number of regulatory instruments and policies. Regulatory acts explicitly relevant to this DIA include:

- *Canada National Parks Act*, 2000;
- *Canadian Environmental Assessment Act*, 2012;
- *Impact Assessment Act*, 2019;
- *Species at Risk Act*, 2002;
- *Migratory Birds Convention Act*, 1994;
- *Fisheries Act*, 2019;
- *Canadian Navigable Waters Act*, 2019;
- *Canada Transportation Act,* 2016; and
- *Canadian Environmental Protection Act*, 1999.

The Project will undergo a regulatory review and permitting process with PCA and Department of Fisheries and Oceans (DFO) following the environmental assessment approval process. During this process, additional site-specific information will be collected at applicable crossings or at other locations where construction will occur below the high water mark to support permit applications, as required. The information collected in the field will facilitate any required DFO *Request for Review* needed for the water crossing installations and encroachment on watercourses due to highway widening.

Project Alternatives

Currently, the TCH through YNP has a higher collision rate than average for similar highways in BC and the forecast increase in traffic volume may prolong or contribute to existing roadway maintenance issues and visitor safety, with a forecasted summer traffic volume by 2046 of 23,000. Increased vehicle use is anticipated to increase the barrier effect on wildlife and wildlife mortality rates. The option of not proceeding with TCH twinning would prolong existing roadway maintenance issues, associated visitor safety and potential for harm to wildlife species. Parks Canada's vision and goals for YNP would not be met with this "no Project" option; therefore, this option was not evaluated in the DIA.

Given that the Project is the twinning of the TCH, alternative Project routes were not explored. However, segments of the Project footprint were adjusted throughout the Project planning phase, as field data and constraints on environmental elements became available. Several route considerations and adjustments were made between 2016 and 2019 through an iterative approach between Project footprint engineering design and environmental elements and constraints.

Design Standards

The design standards for the Project are consistent with the previously twinned sections of the TCH within BNP and YNP. Generally, the highway will be designed in accordance with the current Transport Association of Canada Guidelines for Canadian Roads. Additionally, and where applicable, BC Ministry of Transportation and Alberta Transportation Guidelines will also be utilized to inform aspects of the highway design. Design standards for bridges and wildlife crossing overpasses will follow CSA S6-14, Canadian Highway Bridge Design Code.

The Project will be widened from two lanes to four lanes and designed as a Rural Arterial Divided highway with a design speed of 100 km/hr, and a posted speed of 90 km/h, which is consistent with the current posted speed. The cross section of the proposed four-lane highway will consist of two 3.7 m driving lanes in each direction along with, 3.0 m outside shoulders and a minimum 1.5 m inside shoulder. The revised alignment will overlap or be immediately adjacent to the existing alignment. Highway capacity and level of service will be based on a 30 year projected traffic horizon. As such, consideration will be given to future provision for passing or truck climbing lanes during this time horizon.

The two sets of driving lanes will be separated by a grassed median (depressed median) or a raised concrete barrier. The depressed median arrangement will be used wherever practical because it is preferred from a safety, maintenance operations, and aesthetic perspective. In sections where the existing terrain and physical constraints are more challenging from a design perspective, a narrower concrete barrier median style cross section will be utilized.

Remote avalanche control systems are not anticipated to be part of the Project. Engineered debris control systems will be identified and developed during the detailed design phase of the Project.

Wildlife Crossings and Fencing

The TCH has been a partial barrier to wildlife movement and a source of WVCs since its completion in 1958. The Project design includes the installation of wildlife exclusion fencing with associated wildlife crossing structures. Wildlife fencing will be installed within the cleared roadside area of the expanded highway footprint to prevent animals crossing the highway except at wildlife crossing structures and to reduce the chances of WVCs. Where locations have been identified in YNP that may not be conducive to wildlife exclusion fencing, alternative mitigations measures have been identified.

Although effective in reducing the occurrence of WVCs, installation of fencing along large stretches of the highway will likely impact habitat connectivity for most wildlife species if proper mitigation measures are not implemented. The incorporation of wildlife crossing structures as part of the Project design is planned to facilitate wildlife movement across the highway and increase habitat connectivity during the operation phase.

Bridges

It is anticipated that seven existing watercourse crossings and the CPR overheads will require a new companion bridge structure to accommodate the twinned four lane highway. Each of the existing bridges will be replaced or repaired based on compatibility with the upgraded highway geometry and design criteria, remaining service life and known maintenance, operational and safety issues. The existing bridges that will be repaired and upgraded from two lanes to four lanes are:

- KP 91+000 – CPR;
- KP 92+400 – CPR;
- KP 106+750 – Ottertail River; and
- KP 123+600 – CPR.

The existing bridges that will be demolished and replaced with a new structure are:

- KP 93+750 – Kicking Horse River;
- KP 100+750 – Kicking Horse River/CPR; and
- KP 121+300 – Kicking Horse River.

New bridges will be constructed to replace the existing culverts at the following locations:

- KP 88+500 – Sherbrooke Creek;
- KP 103+000 – Boulder Creek; and
- KP 121+200 – Kicking Horse River East Channel.

Additional bridges may be required based on evaluations of existing watercourse crossing structures. All new bridge structures will be designed to accommodate wildlife passage.

Schedule

It is anticipated that when funding is allocated, the Project will require a multi-year construction period spanning several distinct phases. For the purpose of the DIA and for determining temporal effects, a construction period lasting over a minimum of eight years if continuous funding is available has been assumed. A construction schedule will be developed in conjunction with the Lake Louise, Yoho, Kootenay (LLYK) Field Unit in consideration of available funding, constructability, sensitive environmental timing periods and visitor use patterns.

Effect of the Environment on the Project

Environmental factors can have a variety of effects on the Project. Landslides, avalanches, extreme weather, climate change, flooding and icing and wildfire and wildlife encounters are environmental features with the potential to affect the Project. Project design has considered the potential for the environment to effect the Project through these environmental factors, including climate change, and appropriate mitigations have been incorporated including ensuring watercourse crossing structures are able to accommodate higher flow conditions.

Public and Indigenous Consultation and Engagement

In 2016, Parks Canada announced the beginning of formal public consultations on the project. A public and Indigenous participation plan was developed to engage the public, stakeholders and Indigenous groups and provide opportunities for interested parties to share comments and feedback. In this first phase of consultations, Parks Canada engaged early with key stakeholders, local residents, neighbouring municipalities and Indigenous groups.

The following subsections summarize Parks Canada's engagement and consultation activities to date.

Public Participation

In 2016 and 2017, a series of one on one meetings were undertaken with key stakeholders and a public open house was held in the community of Field, BC to share information about the project and preliminary highway design and to seek feedback and comments. Key stakeholders were also notified of the TOR prepared for the DIA, and that it was available for review upon request.

A four-week public comment period for the DIA commenced with posting of an executive summary in both official languages on the Yoho National Park and Government of Canada Consulting with Canadians websites. Information describing the decision-making process, how the full report could be accessed and comments submitted was outlined. Public notices describing the process and inviting the public to participate, were placed in local newspapers. Information packages were sent to core stakeholders and local municipalities inviting feedback on the DIA and/or executive summary. The option of requesting a face-to-face meeting for further discussion was identified. Public open houses will be held in both Field, BC and Golden, BC for opportunity to engage and provide feedback on the DIA and the Project.

Indigenous Engagement

Concurrent to public engagement activities, Indigenous groups were notified of the Project and early discussions initiated with interested Indigenous groups.

The Project falls within the traditional territories of the Ktunaxa and Secwépemc Nations. Parks Canada entered into consultation protocol agreements and associated capacity funding agreements with the Ktunaxa Nation Council (representing the four Ktunaxa Nation bands) and the Shuswap Indian Band (serving as lead community on behalf of the five Secwépemc Nation bands collectively referred to as the Pespesellkwe including Splatsin, Neskonlith Indian Band, Adams Lake Indian Band, Little Shuswap Lake Indian Band), respectively, to support their participation in the impact assessment process and consultations on the project. The TOR for the DIA was also shared for opportunity to comment on the VCs. The Ktunaxa Nation and Shuswap Indian Band also participated in field assessments as part of the DIA (e.g., archaeology and fisheries assessments).

Input from both the Ktunaxa Nation and the Shuswap Indian Band (on behalf of the Pespesellkwe) is included in the DIA. Parks Canada continues to consult directly with Indigenous groups to discuss potential impacts on potential Indigenous rights, interests and mitigation measures.

At the end of both the Indigenous and public consultation process, Parks Canada will review, consider and summarize all comments received to refine this DIA as necessary. An overview of the Indigenous and public participation activities and a summary of comments received will be prepared by Parks Canada and included in the final DIA. The final DIA and Indigenous consultation outcomes informs the Superintendent's decision on whether the Project should proceed and under what conditions.

Assessment Methodology

Assessment boundaries were used to set the spatial and temporal limits of the DIA. The boundaries were defined to capture the spatial areas and temporal considerations in which the Project and various phases of the Project, are expected to interact with VCs. Spatial and temporal boundaries were also intended to capture past, present and reasonably foreseeable effects that might interact cumulatively with the incremental effects of the Project.

The Local Study Area (LSA) for most disciplines extends 100 m on either side of the Project Footprint which centres on the existing TCH alignment, and totals 1,217.7 ha. The LSA includes existing/current disturbance footprints within YNP that will be reclaimed/restored as part of the project. For most VCs, the assessment focused spatially on effects within the LSA which captures both the immediate area of construction as well as other areas potentially impacted from other projects and activities. A portion of the LSA extends beyond the western YNP boundary.

Regional scale effects were discussed where appropriate for cumulative effects. Data collected at larger scales were used to measure broader-scale existing natural and human conditions and provide regional context for the maximum predicted geographic extent of combined direct and indirect effects from the Project on VCs.

The temporal boundaries of the assessment are broad, with cumulative effects extending back in time as far as the late 1800s, when the CPR line was built, and as far forward as present day considered to provide context to help define the importance of incremental effects of the Project to VCs. The residual effects assessment focuses on changes caused by the Project between existing/current conditions through to operation of the Project. The Project has not been funded yet, but it is anticipated that site preparation and construction will be completed in segments based on constructability and available funding. Construction includes short term effects associated with equipment and workers on site as well as reclamation. The operations phase of the Project is considered permanent and includes the long-term operation and maintenance activities with the permanent additional two lanes of the highway.

The list of VCs selected for the Project considered several factors, including:

- the presence, abundance and distribution within, or relevance to, the Project area;
- the potential for interaction with the Project and sensitivity to effects;
- species of conservation status or concern;
- regulatory requirements;
- ecological or socio-economic value to communities, government agencies and the public; and
- traditional, cultural and heritage importance to Indigenous people.

Effects are measured based on existing environmental and cultural conditions. The understanding of existing conditions was based on reports from previous broad scale studies, site-specific surveys, previous environmental assessments within the Project area, field investigations conducted 2016 through 2019 specifically for this Project and desktop review and information provided by PCA.

Baseline data are used to describe the conditions of the existing environment for each VC. Existing/current conditions were described for each environmental VC to provide an assessment baseline against which residual effects of the Project could be measured. Data from field surveys are supplemented with information from government databases, regional studies, published and unpublished literature and information obtained during discussions with PCA.

The effects analysis considers the possible interactions between the Project and the VCs, within the identified spatial boundaries. Potential effects of the Project on VCs are determined by comparing the existing environment to those that are expected to result from Project construction and operations without consideration of mitigations. Mitigation measures are then applied to either eliminate, avoid, or reduce potential effects.

The DIA considers the potential interactions between the Project and each VC. Potential interactions were identified based on literature review, field investigations and documented evidence from the construction and operations of similar projects. This step identified key environmental risks prior to identifying mitigation. Mitigation in the next step of the assessment can minimize or eliminate potential Project effects.

Mitigation was identified for each VC, as required and appropriate, to minimize or reduce environmental impacts and risks associated with the Project. Mitigation began in 2016 with the design concept phase using an iterative approach between engineering planning and design and environmental constraints mapping prepared following environmental desktop and baseline field studies. The focus was avoidance or minimization of environmental effects through the iterative planning process.

Assumptions about the type of mitigation used in detailed engineering design were made for the purposes of this DIA. For some mitigation measures, final decisions on design and implementation will occur during the detailed design stage of the project. Failure of the final design to meet these assumptions would require re-assessment of the conclusions provided in this DIA. Mitigations for which uncertainty was present and for which assumptions must be met in the final design are described in the uncertainty and monitoring section for each environmental VC.

Where mitigation measures are anticipated to not fully eliminate Project effects on a VC, these effects are then classified as residual effects.

Residual effects of the Project are those that are predicted to persist after successful implementation of all recommended mitigation. Residual effects, where identified, were characterized using the assessment criteria based on *Canadian Environmental Assessment Act* principles outlined in Table ES-1.

Table ES-1: Definitions of Criteria used to Classify Residual Project Effects

Criterion	Description	Criterion		Definition
		Criterion Level	Code	
Direction	The value of the effect in relation to the environment	Positive	P	Net gain or benefit to the VC
		Neutral	NE	No change to the VC
		Negative	N	Net loss or adverse effect on the VC
Magnitude	A measure of the intensity of the effect or the degree of change caused by a project relative to baseline conditions or guideline values	Negligible	N	No discernible change on existing conditions
		Low	L	Effect is detectable but within recorded existing conditions
		Moderate	M	Effect is expected to be at or slightly exceeds existing conditions
		High	H	Effect exceeds thresholds and causes detectable change in VCs
Geographic Extent	The spatial extent to which a Project effect can be detected	Site	S	Effects restricted to the Project Footprint
		Local	L	Effects restricted to the LSA
		Regional	R	Effects extending beyond the LSA
Frequency	The number of times the effect happens over the temporal scope of the Project	Infrequent	I	Occurs or has the potential to occur once over the duration of the Project
		Frequent	F	Occurs or has the potential to occur periodically over the duration of the Project
		Continuous	C	Occurs or has the potential to occur continuously over the duration of the Project
Duration	The period over which the natural or human resource effect will be present. The amount of time between the start and end of a Project activity or stressor, plus the time required for the effect to be reversed	Short-term[1]	S	Effect occurs during the construction phase
		Medium-term	M	Effect continues for up to two years after the construction phase
		Long-term	L	Effect continues for the duration of the Project through operation
Reversibility	An indication of the potential for recovery of the VC/key indicator from the Project effect. Reversibility implies that the effect will not result in a permanent change to the state of the VC compared to similar environments not influenced by the Project	Reversible	R	Effect will not result in a permanent change to a VC or indicator
		Not reversible	I	Effect will result in a permanent change to a VC or indicator

Note:

[1] For duration of the human environment VC's, the construction period of 8 years is not considered short term relative to human experience. Refer to Section 7.2.

Where residual effects are anticipated, further analysis is carried out to determine the magnitude and duration and extent of the effect. Magnitude, geographic extent and duration are the principal criteria used to predict significance of residual effects.

Summary of Effects

The effects of the Project on various Valued Components, organized by discipline, are described below. A full rationale for the selection of VC indicators, existing environment surrounding the VC, potential effects of the Project on VCs, mitigations and predicted residual effects is provided in the DIA.

Terrain and Soils

The valued components identified for this discipline are terrain (including rare/unique landforms of features) and soils. Terrain and soils are "foundational" components of the environment in which vegetation and ultimately wildlife habitat are expressed. Soils develop within the surficial materials that cover an area and are an expression of geology, topography, glacial history, geological modifying processes, drainage and slope position. As a result, the inclusion of terrain and soils as a VC is key to the evaluation of environmental effects.

Maintaining or restoring ecological integrity is the first priority of park management. For the purposes of this Project, this includes the maintenance of soil quality, quantity and distribution and landform distribution to support healthy ecosystems.

Natural features of geological feature of interest within the LSA include a hydrothermal pipe was exposed during rock profiling work, a "natural through cut" that appears to have been formed by water erosion scouring through the bedrock and depositing rounded cobbles and boulders, colluvial/fluvial fans and cones, braided river channels and avalanche tracks. If additional geologic features of interest are identified during construction, these will be referred to the Environmental Surveillance Officer to determine the appropriate course of action

Potential effects to Terrain and Soils can occur during construction and operation phases of the Project. Effects can result from the removal of vegetation cover, soil stripping, blasting, drilling, scaling, excavation, backfilling and grading activities that will be associated with the twinning of the highway.

While changes to existing slopes and natural drainage conditions through construction and operation activities have the potential to affect terrain stability, it is not anticipated that project activities undertaken with Best Management Practices (BMPs) and implementation of mitigation strategies will result in increased instability. Project detailed engineering design and BMPs assume that proper field investigations have been completed to identify both unstable slopes, as well as those slopes that are potentially unstable. With the implementation of proposed mitigation strategies, coupled with BMPs, it is not expected that changes to the terrain during the construction and operation phases of the Project will result in potential adverse residual effects.

The soils within the Project area are generally considered to be young and poorly developed due to the highly dynamic environment found within the LSA. Most of the upland soils are also considered to be thin, rarely exceeding a metre in thickness. However, soil erosion is a concern within the LSA due to sloping topography, medium to coarse-textured materials, removal of vegetation cover and subsequent soil disturbance. Soil quality can be affected because erosion can remove finer particles and organic materials from bulk soil. Disturbed soils are susceptible to wind and water erosion due to factors such as absence of vegetation, steep slopes, desiccation and rainfall.

Overall, site clearing, contouring, excavation, and other activities associated with the construction and operations phases of the Project are expected to result in minor changes to soils when using the mitigation strategies proposed. As a result, these interactions are considered not to result in potential adverse residual effect to soils.

The confidence in the prediction of the Terrain assessment is considered moderate. Although terrain and terrain stability mapping was completed at scales of 1:5,000 to 1:2,000, and subsequently field verified, the natural environment within YNP is dynamic and inherently unstable. Not all effects of the environment on the project can be predicted and continual monitoring of slopes will be required. If any evidence of slope movement is observed, a detailed geotechnical investigation will be undertaken.

Soils mapping relied upon previous small scale mapping ranging from 1:25,000 to 1:50,000 scales. Mitigation to manage soils are expected to mitigate effects. Prediction confidence for effects to soils is considered high.

Vegetation and Wetlands

Vegetation VCs were selected in consideration of potential Project effects on vegetation during construction and operation, which are anticipated to include:

- direct loss of vegetation species, including listed plant species;
- direct loss of vegetation communities and ecological integrity, including wetlands, Zone I – Special Preservation areas and listed and uncommon ecological communities;
- loss of species diversity and community composition through an introduction of invasive plant species; and
- effects due to changes in surface water flow, sedimentation, erosion and contaminants.

Maintaining or restoring ecological integrity is a key priority of park management. The valued components identified for this discipline are listed plants, wetland communities and listed and uncommon ecological communities. For the purposes of the DIA, the maintenance of healthy and diverse plant populations and plant communities was applied as the assessment endpoint for vegetation VCs.

Two federally listed species, whitebark pine and limber pine are known to occur in YNP where elevations and habitat conditions are appropriate. Whitebark pine is listed as Endangered on Schedule 1 of SARA and therefore has legal protection within the park. Limber pine was assessed as Endangered by COSEWIC but has not been placed on Schedule 1 of SARA. While limber pine does not have legal protection

requirements within the park at this time. Best practices would involve avoiding limber pine given its COSEWIC status.

Based on elevation, there is relatively low potential for whitebark pine habitat, but potential for limber pine habitat within the LSA. A literature review and field surveys of the area determined that the LSA has very low potential for these species and their habitat. Based on available ELC mapping, communities that include these two species are not present within the LSA and none were observed during targeted field surveys. However, critical habitat mapping for whitebark pine does show potential for critical habitat to intersect the LSA at two locations near the eastern end of the Project.

While provincially listed plant species are afforded no direct legal protection within YNP and have no legal protection through federal legislation, the designation as a species of conservation concern merits assessment for the Project as one of the tools to maintain biodiversity within the park. At the provincial level, one blue-listed plant, McCalla's dwarf braya has been historically observed within or adjacent to the LSA. During field surveys in 2016, 2017 and 2018, only the yellow-listed dwarf braya, which is not considered rare in BC, was identified. Due to the similarities between the blue- and yellow-listed dwarf braya subspecies, and because the blue-listed subspecies could not be relocated during multiple field seasons, this species is assessed in the DIA but no species or location-specific mitigation has been identified. Overall, residual effects on Species at Risk listed plants and tracked and watched plant communities are not anticipated.

Site preparation and activities associated with construction of the Project footprint could contribute to the loss of habitat for federally and provincially listed plants species that may be detected within the Project footprint through direct removal of microhabitat that supports these species, as well as through changes to habitat through the alteration of hydrology, sedimentation and erosion, spills and the introduction of invasive plant species. The effect associated with clearing will be restricted to the footprint. Because most disturbance will be permanent, the effect is considered irreversible and continuous throughout the long-term operation of the Project.

Listed plant habitat will also be affected by changes to habitat quality associated with changes in hydrology, spills, sedimentation and erosion and introduction of invasive plant species. The effect on listed plant habitat associated with changes to habitat quality have the potential to extend beyond the Project footprint but will be restricted to the LSA. This effect on listed plant habitat is anticipated to be long-term and continuous throughout operations, but reversible with the application of appropriate mitigations.

Overall, the effect of the Project on listed plant habitat availability is predicted to be negative. This effect is predicted to be localized but moderate in magnitude because of the permanent loss of floodplain habitat.

Development of the Project is expected to change the area of wetland communities within the Project footprint and has the potential to change the community condition within wetlands and Zone I – Special Preservation areas.

In the LSA, mapping identifies 39.5 ha of wetland communities under existing conditions, excluding anthropogenic wetlands. Approximately 2.5 ha of wetlands in LSA will be directly affected by clearing associated with the Project footprint. The Project footprint has been designed to achieve no net loss of wetland function and naturally occurring and functioning wetlands have been avoided to the extent practicable during Project design. However, once wetlands are removed the effect is considered continuous until functional habitat is reclaimed or offset. Wetland loss will be compensated within YNP through the creation of new wetland habitat, or through the restoration of degraded wetland habitat. For the purposes of this analysis the loss of all wetlands is considered long-term, but reversible. Although the Project is anticipated to have a negative effect on wetland community availability, net positive impact could be achieved for wetlands through the creation of compensation wetlands within YNP once functional ecosystems have established. Therefore, the magnitude is anticipated to be low.

Changes in water flow and quality and the introduction of invasive plant species have been identified as potential Project activities that could result in negative changes to wetland community condition in wetlands adjacent to the Project footprint, including the Zone I – Special Preservation Area wetlands, Leanchoil Marsh and Ottertail Flats.

The effect on wetland community condition including Zone I – Special Preservation Area wetlands has the potential to extend beyond the Project footprint, but it is anticipated to be restricted to the LSA. The effect on wetland community condition is anticipated to be long-term and continuous through operations, but reversible with the application of appropriate mitigations. During Project design, engineering measures will be developed to maintain hydrologic connectivity. An *ESC Plan* and *Spill Response Plan* and *Waste Management Plan* will be developed and implemented during construction. Invasive plant control measures will be implemented at the planning and design, construction, and operations phases; therefore, wetland community condition is not predicted to be affected by invasive plant species introduced or spread during construction, or by colonizing soils disturbed by the Project. Overall, the Project effect is predicted to be low in magnitude.

Site preparation and activities associated with construction of the Project footprint will contribute to a negative effect on the Western Red Cedar community availability. Approximately 0.9 ha will be directly affected by clearing associated with the Project footprint, most of which will affect younger seral stage trees and lower quality habitat. Therefore, the effect is predicted to be low in magnitude. The effect will be continuous over the long-term but, reversible with reclamation of suitable habitat within the LSA, which, depending on area reclaimed, will have a long-term positive effect on the Western Red Cedar community.

The Western Red Cedar community condition will be negatively affected by erosion and the introduction of invasive plant species. Project design will use geotechnical guidelines and slope stability criteria to minimize erosion potential. Invasive species have the potential to alter forest condition, particularly where the edge-to-interior ratio is high. Implementation of appropriate invasive plant species control would minimize the potential for invasive species to occupy the Western Red Cedar community adjacent to the Project. Both erosion and invasive species have the potential of affecting this community locally, and effects on listed and uncommon ecological community condition are predicted to be continuous and long-term, but reversible with appropriate control measures. During Project planning, design, construction, operations, and implementation of mitigation measures, an ESC Plan and invasive plant control measures will be implemented. Therefore, the Project effect is predicted to be low in magnitude.

The residual effects characterization for listed plant species is based on a strong understanding of habitat associations within the LSA and YNP, and a good understanding of threats to this VC. However, habitat association was not mapped or quantified, creating uncertainty about the amount of change in habitat availability in the LSA.

Additional pre-construction surveys could detect listed species occurrences prior to construction. It is assumed that the mitigation measures proposed are effective strategies for reducing Project effects on listed plant species. Although there is uncertainty in the vegetation assessment, the effects analysis for listed plant species was conservative and there is a moderate degree of confidence in the residual effect classification for vegetation.

Wetland compensation ratios will be developed to reflect the uncertainty associated with reclaiming functioning wetlands. Effective application of design measures, BMPs, and other mitigation measures are likely to reduce changes to wetland availability and condition. Although there are uncertainties in the analysis of effects on wetlands, the overall assessment was conservative, and there is a moderate degree of confidence in the residual effects classification for wetlands.

There is a moderate understanding of construction effects on terrestrial communities. Overall, there is a high degree of confidence in the residual effects classification for the western red cedar community.

Wildlife

The wildlife VCs selected for the DIA were chosen to align with YNP Management Plan objectives. Instead of individual species, ecological functions and processes were selected since they provide a more holistic view of how the Project could potentially impact ecological integrity. Maintaining or restoring ecological integrity is one of the primary goals identified for YNP, as outlined in the current YNP Management Plan. Several action items are identified in the YNP Management Plan to help meet ecological integrity objectives, including: reducing highway-related mortality for wildlife, maintaining important habitats for species at risk and maintaining wildlife movement patterns and corridors.

The selection of Project specific VCs was completed in consultation with the PCA LLYK Field Unit and follows the TOR. Wildlife mortality, habitat and scarce resource availability, and wildlife movement and habitat connectivity were selected as VCs for the wildlife component of the assessment.

Woodland caribou are designated as Threatened and under Schedule 1 of the SARA; however, the species is ranked as Non-active under COSEWIC and classified as ‘Absent’ from the park. All woodland caribou detections within YNP are unconfirmed historical reports and caribou are not expected to range within the boundaries of this Project. As a result, no impacts to woodland caribou are anticipated and the species is not assessed within the DIA. A draft Type II Matrix Critical Habitat plan for the species does exist, which includes portions of the LSA (Kinley, T. 2018b, pers. comm.). While vegetation clearing is normally discouraged within Type II Matrix habitat due to the potential to increase prey (and consequently predator) numbers, in this case the new clearing will be fenced to prevent large animal access, effectively reducing the amount of early-seral areas available for other prey species to forage.

A number of species at risk are present in YNP and effects of the Project on the VCs are considered. These include one arthropod species (western bumble bee), one amphibian species (western toad), 15 bird species (barn swallow, bank swallow, black swift, bobolink, common nighthawk, evening grosbeak, ferruginous hawk, horned grebe, olive-sided flycatcher, peregrine falcon, red-necked phalarope, rusty blackbird, short-eared owl, yellow rail and western grebe) and five mammal species (American badger, woodland caribou, little brown myotis, grizzly bear and wolverine). After mitigation, positive residual effects of the Project on wildlife movement and habitat connectivity are expected for many species, although a high degree of variability is anticipated. Wildlife movement and habitat connectivity has been selected to carry forward through residual effects analysis.

Residual impacts related to mortality come from WVCs and interactions with people. Mortality will be reduced because of the Project due to the presence of wildlife exclusion fencing. By incorporating proposed mitigations, the Project should reduce WVCs, leading to an overall positive effect to all wildlife species, especially ungulates and large mammals. Residual effects are predicted to be positive in direction, high in magnitude as the reduction of WVCs is expected to be detectable because of the Project, local in geographic extent, continuous in frequency, long-term in duration and reversible in direction with the removal of the mitigation measures.

No residual effects are expected for large mammals in relation to incidental take as it is expected these species are mobile enough to avoid construction activities. Impacts to small- to medium-sized mammals, birds, amphibians and reptiles as a result of vegetation clearing could occur. Effects to small mammals, birds and amphibians will be limited to the construction phase, as some species are not able to move out of the way of construction equipment. Effects are predicted to be negative in direction and low in magnitude as incidental take of small mammals, birds, amphibians and reptiles would differ from existing condition, but mitigation measures are in place to limit incidental take. Predicted effects are local in geographic extent as it is expected to only occur in the LSA, infrequent and short-term in duration as the effect is limited to the construction phase of the Project and considered to be reversible.

The Project is not expected to lead to an increase in human-wildlife conflicts as compared to existing conditions following the application of the recommended mitigation measures. Although during construction there will be more workers and more attractants for large mammals, such as bears to the TCH, proper containment and disposal of these attractants, as well as anticipated avoidance of the construction activities are expected to minimize this effect. The magnitude of the effect is predicted to be low as human-wildlife conflicts can increase slightly during construction. Effects are predicted to be local in geographic extent, infrequent in frequency, short-term in duration, and considered to be reversible with application of mitigation measures and following construction.

Residual impacts related to wildlife habitat and the availability of scarce resources are related to both the direct loss of habitat for the highway widening, and indirect loss of habitat suitability due to sensory disturbances including noise and light during construction. In general, direct habitat loss will negatively affect almost all species except for species such as ground squirrels which perceive additional disturbed habitat as increased foraging opportunities. Habitat loss is moderate in magnitude as the effect is expected to slightly exceed existing conditions, local in geographic extent, continuous, long-term occurring through operations but reversible as a mitigative measure for the Project includes reclaiming and restoring existing/current disturbance footprints for YNP. The Project has the potential to cause

residual effects for species at risk in relation to loss of habitat, however, this prediction is uncertain in the absence of mapped or defined critical habitats under recovery plans for species at risk such as the olive-sided flycatcher and little brown myotis.

Residual Project effects to the Ogden mineral lick are expected to be negative in direction as the Project footprint will impact this location. The mineral lick area that is expected to be directly lost is not expected to re-form following construction, but an alternative/replacement mineral lick will be created meaning the duration of the effect is long-term and reversible. The magnitude of this effect is high, regional in geographic extent and continuous.

Wetland habitat loss will be compensated within YNP through the creation of new wetland habitat, or through the improvement of degraded wetland habitat. Given the uncertainty associated with reclaiming wetlands affected by development, the assessment assumed that wetland compensation ratios will be developed to accommodate uncertainty in reclamation success and time lag. For the purposes of this analysis the loss of all wetlands are considered to occur at the site level, be long-term in duration, but reversible. Residual Project effects to wetlands are expected to be negative in direction and low in magnitude as wetland avoidance has been captured within the Project design. Project effects on wetland habitat are expected to be local in geographic extent, and infrequent.

Residual effects of the Project in relation to the indirect loss of habitat through sensory disturbance is expected to be negative in direction and moderate in magnitude since the predicted increase in noise levels because of the Project is considered to be at, or slightly exceed existing conditions. Predicted residual effects are expected to be local in geographic extent as it is anticipated to reach beyond the footprint but within the LSA for some species. Anticipated disturbance to wildlife from noise and light will be higher during the construction phase of the Project but as traffic volume is not expected to increase because of the Project, sensory disturbance levels during the operation phase will likely reflect current levels. Predicted residual effects are assessed as infrequent, as construction will move in phased approach within the LSA. Predicted residual effects are expected to be short-term in duration and reversible once the Project is in operations.

Residual impacts related to wildlife movement and habitat connectivity are positive in direction for many wildlife species as installation of crossing structures and fencing is expected to increase habitat connectivity and wildlife movement across the TCH, compared to current conditions. As a result, the Project is predicted to also lead to increased genetic connectivity on the landscape. The magnitude is dependent on species and is predicted to range from medium for species such as mesocarnivores, amphibians and reptiles to high for species such as mountain goat and grizzly bear. The geographic extent of residual effects is also dependant on species and expected to range from local for smaller wildlife species to beyond regional for larger wildlife species. The frequency and duration of residual effects are predicted to be continuous and long-term, respectively. Effects would be reversible if crossing structures and fencing were removed.

Residual Project impacts on wildlife movement and habitat connectivity in relation to sensory disturbance of wildlife are expected to be negative in direction, moderate in magnitude, local in geographic extent, infrequent, and short-term in duration. Residual effects are limited to the construction phase of the

Project and are expected to be reversible after Project construction is complete. Project effects of noise and light during the operational phase are not expected to exceed existing conditions.

The effects of the Project should be viewed relative to the existing environment. That existing environment includes an unmitigated TCH with frequent WVCs, reductions in habitat effectiveness because of the existing road-effect zone and existing barrier to movement effects. The Project will have a variety of adverse and positive effects on wildlife.

The Project will have an overall positive effect on the reduction of WVCs for large mammals and an overall positive effect for most wildlife species in relation to re-establishing wildlife movement, connectivity and gene flow of wide ranging populations. The Project will result in a negative adverse effect in relation to habitat loss and scarce resources for some species with the magnitude of this effect low for most species but ranging to moderate for species preferring Montane forest or wetland habitats, and high for mountain goats and their use of the Ogden mineral lick. Additionally, the Project will also have an overall positive residual effect for certain species, as, ultimately, the Project will re-establish connectivity to habitat that was isolated due to the original development of the TCH.

Impact predictions for wildlife mortality were made with a moderate to high degree of confidence, given the data available on TCH mitigation and its effectiveness. Confidence that the exclusion fencing will be an effective mitigation is high for ungulates and grizzly bear, and moderate for the majority of mesocarnivore species with the inclusion of the buried apron. Small mesocarnivores like weasels and martens will likely be able to fit through gaps in wildlife fencing.

Given the extent of the Project footprint, there is a high degree of confidence in the predicted direct effects on wildlife habitat and scarce resource availability. Confidence in predictions on quantitative loss of critical habitat and associated effects for associated species at risk are low. Confidence in the presence of arthropod species of conservation concern (i.e., bumble bees) within the LSA is low due to a lack of surveys in YNP for these species.

The source of the Ogden mineral lick has not been confirmed, but the feature appears to have some naturally-occurring elements and is also likely influenced by the use of road salt on the TCH. Since development of the Project footprint will impact the Ogden mineral lick adjacent to the existing TCH, the magnitude and confidence rating for this site is high. Confidence in the creation of a viable alternate semi-natural or artificial mineral lick is moderate.

Because the reaction of different species to sensory disturbance is poorly understood, the assessment assumed that all individuals of all wildlife will be displaced by the TCH. Therefore, the assessment is conservative, and confidence that impacts will not be greater than predicted is high.

For species such as grizzly bear, the current amount of research and documentation of crossing structure use and gene flow provides a moderate degree of confidence in the impact prediction. However, for other species such as mountain goat or Canada lynx, very few studies have documented use of wildlife crossing structures. The consequences of the Project and the efficacy of proposed mitigation measures are relatively uncertain for several species.

Hydrology and Aquatic Resources

Maintaining or restoring ecological integrity is the first priority of park management. For the purposes of this Project, this includes maintaining healthy aquatic resources which include water quality and flow, and fish and fish habitat. Hydrology, surface water quality and fish and fish habitat were selected as VCs because the Project has the potential to affect water quantity and flow characteristics, result in an increase in suspended sediment and result in fish injury or mortality and/or a loss of, or disturbance to fish habitat.

The KHR is a large fish-bearing watercourse, which generally parallels the TCH within the Project area and is a tributary of the Columbia River system. Ten fish species have been documented in the KHR. There are native and non-native fish species in the KHR where the non-native species (brook trout, lake trout and rainbow trout) have been introduced. Redside shiner have been documented in a tributary of the KHR, and therefore, are assumed to be present in the river. Some of these species have also been identified in the tributaries within the Project area.

Two federally and/or provincially protected species of conservation concern, bull trout and westslope cutthroat trout, were identified to occur in the hydrology and aquatic resources. Westslope cutthroat trout (Pacific populations) are designated federally as 'Special Concern'. Some headwater lakes (i.e., Lake O'Hara, Morning Glory Lake) in YNP had been historically stocked with westslope cutthroat trout. The potential for westslope cutthroat trout to occur in the waterbodies and watercourses crossed by the Project is low, however, individuals have the ability to move down from the lakes and enter into the KHR and reside in the LSA. Bull trout (Pacific populations) are designated provincially as 'Blue' (Special Concern). Due to the proximity of the crossing locations to the KHR mainstem, bull trout have reasonable potential to occur in the waterbodies and watercourses crossed by the Project, provided that a barrier to fish passage is not present in the downstream portion of a waterbody or watercourse near the confluence with the KHR

Currently, there are no SARA listed Endangered or Threatened fish species in the Project LSA or RSA. Westslope cutthroat trout are listed under SARA as 'Special Concern'.

Construction or extension of crossing structures in waterbodies or watercourses crossed by the TCH will be required in cases where water flow is present during construction. Changes to hydrology because of water diversions can include localized changes to channel morphology, streamflow and/or water levels upstream and downstream of the work area. In addition, localized changes in flow conditions can occur at the water intake and discharge locations for the diversions, which could result in changes in rates of erosion and sedimentation within waterbodies or watercourses. There is also an increased opportunity for erosion of the streambed and banks within the work area due to disturbance during construction, which can alter channel stability and flow regime downstream of the construction area.

A review of the waterbody and watercourse crossings list identified a total of 97 crossings along the TCH alignment in the Project area. Of the 97 crossings for the Project, 65 will be located on drainage paths where no scoured channel is present. Eight crossings will be located on water features that have a scoured channel present with intermittent or seasonal flow. Surface water diversions will not be required at these locations if water flow is absent during construction. A total of 24 crossings will be located on waterbodies or watercourses with perennial flow and a defined channel. These watercourses include six crossing

locations over the KHR or within its floodplain and crossings of Ottertail River, Sherbrooke Creek and Boulder Creek.

Following implementation of Project mitigation measures, the temporary diversion of water to create and maintain a dewatered work area to construct, extend or upgrade waterbody and watercourse crossing structures can result in small, localized changes to surface water quantity during the instream construction period. In addition, construction around waterbodies and watercourses can result in changes to channel morphology, bank stability and flow rates. However, these effects are expected to be localized to the water crossing construction area and due to the short-term nature of this Project activity, no residual adverse effects on the surface water hydrology VC are anticipated.

Construction of the Project footprint, including the upgraded highway, storage and laydown areas and temporary workspaces could result in changes to surface water quantity. Construction of these Project components will result in changes in land cover from predominantly forested or shrub-covered land surfaces to bare ground, low-growing grasses, paved and gravel-covered surfaces. Replacement of permeable surfaces with impermeable surfaces that store little water can reduce infiltration of water into the ground, resulting in accelerated runoff. Potential effects on the hydrology VC include localized increases in runoff rates and runoff volumes reporting to waterbodies and water courses. Increases in erosion and sediment transport/delivery are also possible due to increased runoff rates.

A total of 97 waterbody and watercourse crossings are planned along the TCH and will include installation of concrete and CSP culverts, multi-span and clear span bridges. Although the detailed design of the crossing structures planned at individual locations is not final at the time of preparation of the DIA, it is expected that most of the crossings (likely greater than 90%) will consist of concrete or CSP culverts. Six clear span bridges are planned along the TCH; three over the KHR; and one at each of the Ottertail River, Sherbrooke Creek and Boulder Creek crossings. One multi-span bridge will be required on the KHR at KP 121+300. All of the water body crossings along the TCH will be permanent.

Depending on the type of structure installed, placement of crossing structures could result in changes to channel alignment and form as well as channel cross section geometry. In addition, placement of crossing structures could alter flow conditions upstream and downstream of the crossing. The Project also has the potential to alter the lateral or vertical stability of waterbodies and watercourses resulting from removal of riparian vegetation and disturbance to the stream bed and banks over time. Effects could include localized scouring and/or increased erosion of the channel and streambanks and could occur continuously throughout construction and operations until disturbed areas have been stabilized.

Potential changes in reach and cross-section hydraulics, channel morphology and flow conditions from placement of the Project footprint are expected to occur continuously through the construction and operation phases of the Project, but will be minimized due to design and localized and of low magnitude. Given implementation of the mitigation measures, including the design and placement of appropriate crossing structures (bridges and culverts) and appropriate scour mitigation, no residual adverse effects on the surface water hydrology VC are anticipated.

Project construction has the potential to increase the concentration of suspended sediment in LSA waterbodies and watercourses and result in an adverse effect on water quality. Increases in suspended

sediment concentrations can occur directly due to disturbance and re-suspension of bed materials during instream construction such as installation of culverts or operation of construction equipment in the water and indirectly due increased erosion delivered to the waterbody or watercourse from site runoff. Release of sediment during Project construction could increase total suspended solids and turbidity in the downstream environment. Some changes to water quality within LSA waterbodies and watercourses could, therefore, occur during the Project construction phase.

Activities that can result in increased erosion from site runoff include site preparation, earthworks and stockpiling activities during the construction phase. Site preparation will include vegetation removal, grubbing and stripping of topsoil.

The release of sediment into drainages, waterbodies and watercourses crossed by the Project or that run adjacent to the TCH is expected to be minimal with effective implementation of mitigation and management practices and monitoring during Project construction, including the use of diversions for flowing watercourses where instream work is required.

Changes to water quality from the release of sediment during instream construction and from land disturbance are expected to be minor due to mitigation, use of appropriate construction methods, and adherence to PCA BMPs and other related industry guidance. Consequently, this Project interaction is anticipated to have a minor residual effect on the water quality VC.

Introduction of deleterious substances from spills of fuel or other hazardous materials during construction has the potential to adversely affect water quality. Spills that occur in high enough concentrations could contaminate runoff and surface water. A Spill Response Plan will be prepared in advance of construction in accordance with PCA and industry standard BMPs. The Spill Response Plan will be designed, developed and implemented to protect the environment and workers from exposure and will include measures for storage facilities of hazardous materials and waste to meet applicable federal and provincial requirements. Implementation of spill prevention measures and the Spill Response Plan is expected to reduce the likelihood, extent and severity of spills of fuel or other hazardous materials during Project construction. Given implementation of the mitigation measures, no residual adverse effects on the water quality VC are anticipated.

Project construction has the potential to result in physical injury or mortality of fish. This can occur from the operation of construction equipment in the water, the installation and/or extension of water crossing structures in cases where work is required below the high water mark, and/or placement of fill or other materials in the waterbody or watercourse where fish are present. The use of intakes or pumps can also cause entrainment or impingement of fish. Pressure changes and vibrations caused by blasting during Project construction can also cause injury or mortality to fish. Finally, injury or mortality to fish can also occur during fish rescue activities, which involves removal and relocation of fish away from the isolated work area.

No measurable changes to fish abundance or distribution are expected due to instream construction and use of explosives during construction with effective implementation of mitigation measures, and therefore, no residual effects on the fish and fish habitat VC are anticipated.

The Project will require the construction or encroachment of the highway on the existing channel and bed and banks of the KHR. Sections of the KHR within the Field Flats area will require the highway to be constructed within the floodplain of the KHR and, therefore, result in diversion and/or realignment of the KHR or off-channel habitat within the Project footprint. Encroachment of the Project footprint along or within the floodplain or onto mainstem or side-channel areas of the KHR can affect fish and fish habitat by altering spawning and rearing habitat availability and quality in the LSA and RSA.

Disturbances that can affect fish habitat directly include: operation of construction equipment in the water; excavation of the stream bed and banks; and placement of crossing structures, fill or riprap in the waterbody or watercourse. Direct effects to fish habitat can include changes to the waterbody or watercourse bed and/or composition of bottom substrates; alteration of stream bank alignment and loss of riparian and instream vegetation and/or loss of available habitat due to water diversions. Alteration or loss of specific habitat features, such as pools, aquatic vegetation and bed materials will also cause impairment to existing habitats.

Construction of waterbody and watercourse crossing structures for the Project also has the potential to result in changes to hydrology and channel morphology within the affected portion of the waterbody or watercourse. The design and construction of the Project could alter flow conditions within the KHR upstream and downstream of the construction area. Increased sediment inputs from erosion and bed and bank instabilities could alter the dynamic equilibrium in the channel's ability to transport water and sediment. These changes could in turn affect channel bank-full widths and depths, bed material composition, ratio of pools to riffles, and composition of riparian and instream vegetation. Changes in hydrology, channel morphology and flow conditions can, therefore, affect fish habitat quantity and quality, and potentially fish abundance and distribution. Placement of culverts in waterbodies and watercourses can also cause changes in fish access to tributary habitats in cases where inadequate design and construction of culverts results in the formation of a barrier to fish passage at the crossing location. This can result in a loss of habitat at the crossing location and a loss of access to tributary habitat upstream of the crossing, which can cause habitat fragmentation and reduce availability of spawning and rearing habitats in the LSA.

There are 97 waterbody or watercourse crossings along the TCH, of which 65 were determined to have no potential fish habitat or fish presence due to a lack of sufficient water flow or defined channel. A total of 24 waterbody and watercourse crossings have either confirmed fish presence or fish habitat potential. It is expected that either clear or multi-span bridges will be constructed at five of these locations and that concrete or CSP culverts will be installed at the remaining 19 fish bearing locations. Without mitigation, placement of water crossing structures and changes to hydrology at these locations will result in measurable changes to fish habitat quantity and quality. A DFO *Request for Review* will be required for conducting any work, undertaking or activity in water.

Based on the preliminary mapping review, it was estimated that approximately 2.4 hectares of fish habitat will be lost or altered due to encroachment of the Project footprint on off-channel and floodplain habitats. The specific habitat details including area of fish habitat directly affected will be included in submissions to DFO related to the *Request for Review* for the Project. If DFO determines that Harmful Alteration, Disruption or Destruction (HAAD) of fish habitat will occur because of the Project, an application for Authorization under the *Fisheries Act* will be submitted along with an offsetting plan. The objective of offsetting is to counterbalance unavoidable harm to fish and the loss of fisheries productivity resulting from a project. Offsetting measures support and enhance the sustainability and ongoing productivity of the fishery.

With appropriate design, mitigation and management practices, and monitoring during construction and operation, effects from placement of crossing structures are expected to result in minor, localized changes to fish habitat availability relative to existing conditions. However, for widening of the highway in areas adjacent to the KHR that will encroach on or affect the KHR and off channel habitat, the expected result is moderate and localized changes to fish habitat availability relative to the existing conditions. If required based on the review by DFO, fish habitat lost or altered will be offset with habitat created, restored, enhanced or maintained. In addition, minor changes in fish access to habitats due to placement of crossing structures or widening of the highway will occur because of the Project. Consequently, this Project interaction is anticipated to have a minor residual effect on the fish and fish habitat VC.

Changes to surface water quality from unplanned releases of deleterious substances can affect fish and other aquatic life principally by physical alteration of the habitat available to carry out life processes. Spills during construction and operation that occur in high enough concentrations could contaminate water and cause direct toxicity to fish and aquatic life. A Spill Response Plan will be prepared in advance of construction and implemented during construction and will help to reduce the potential for releases of deleterious substances into waterbodies or watercourses.

No residual effects of the Project were identified for hydrology based on the Project interactions and mitigations. Residual effects of the Project on water quality are predicted to occur due to release of sediment during instream water construction. The mitigation measures effectively reduce the potential, duration and magnitude of these residual effects, but there is still potential for them to occur. The residual effects from the release of sediment on the water quality VC is predicted to be negative in direction, low magnitude, local, with a short term duration, infrequent with the effects being reversible. The likelihood of minor sediment releases is likely as any in-water work generally causes local increases in TSS and sedimentation.

Residual effects on fish and fish habitat are predicted to occur due to physical disturbance to fish habitat, and changes in water quality from sediment releases during construction. The residual effects to fish and fish habitat due to direct disturbance of habitat during in-water construction due to construction of the highway and installation of crossing structures are predicted to be negative in direction, moderate magnitude, local with a short term duration, frequent with the effects being not reversible and certain to occur. However, if required, offsetting will be developed to counterbalance the loss of fisheries productivity resulting from habitat losses associated with the Project, and if so, the residual effects are considered reversible. Residual effects to fish and fish habitat, due to changes in water quality, are

predicted to be negative in direction, low magnitude, local with a short term duration, infrequent with the effects being reversible and unlikely to occur.

The residual effects from the Project are predicted to be of low magnitude, local and of short term duration, and are therefore, not predicted to affect the sustainability of the hydrology and aquatic resources within the local area. Overall, the residual effects from the Project on aquatic resources are not significant.

The residual effects characterization for aquatic resources is based on an understanding of hydrology, water quality, and fish and fish habitat within the LSA and YNP, and a good understanding of effects to the aquatic resources VCs due to the Project. Although there is documented fish presence information for the KHR, there is uncertainty associated with the available fish presence and distribution-related information within the RSA and within the tributaries. However, potential effects to fish and fish habitat were conservatively assessed based on presence or absence of fish habitat at the identified crossing locations.

The effects analysis for the hydrology and aquatic resources VCs has a high degree of confidence in the residual effects classification for aquatic resources. The DFO *Request for Review* process will also be followed for the Project as required. If an Authorization is required under the *Fisheries Act*, an offsetting plan will be developed to support the application and to counterbalance project impacts to fish habitat.

Visitor Experience

Road development in parks can increase visitation if connecting infrastructure and attractions of interest to potential visitors. The Project itself is not an attraction but is being designed in an effort to facilitate safe access to natural attractions or visitor infrastructure. As a result, Project construction or operations are not expected to result in increased total or seasonal visitation by those wishing to experience the attractions of YNP. Project construction activities will be confined to the TCH Highway, and associated nuisance effects such as traffic delays, noise and construction odour, are expected to be localized, and are not likely to influence visitors' decisions to visit the Park's attractions. Continuing to meet UNESCO's Criterion VII of "superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance" as selected as a VC for visitor experience, along with attendance, safety, visitor learning and satisfaction. Project construction is not expected to materially decrease visitation to YNP.

As identified on the United Nations Educational, Scientific and Cultural Organization listing of heritage sites, "The seven parks of the Canadian Rockies form a striking mountain landscape. With rugged mountain peaks, icefields and glaciers, alpine meadows, lakes, waterfalls, extensive karst cave systems and deeply incised canyons, the Canadian Rocky Mountain Parks possess exceptional natural beauty, attracting millions of visitors annually", meeting Criterion VII of the UNESCO World Heritage List criteria for selection.

Attendance has increased in YNP over the past five years by 29%. Yoho National Park's visitation, while substantially lower in terms of total volume of visitors than that of BNP or Jasper National Park, has been increasing at a rate similar to the other mountain parks. Attendance is highest during the months of July and August when families with school-aged children vacation.

The TCH is maintained throughout the year as the country's main coast-to-coast transportation corridor. The speed limit on the TCH falls to 90 km/hr when entering YNP from the west. Data for traffic volumes entering YNP suggests that daily traffic volumes average nearly 7,500 vehicles per day. Traffic volumes peak in in July and August, when between 10,000 and 15,000 daily vehicle trips are made to YNP. Currently, the TCH through YNP has a higher accident rate than average for similar highways in BC and forecast growth in traffic will contribute to an increase in motor vehicle accidents.

The Project's potential adverse effect on public safety during construction is assessed as being of low to high magnitude, depending on the severity of accidents. The effect is local in extent and of medium-term duration, reversible after construction. While the frequency of this effect has not been modelled, accidents are assumed to occur infrequently.

The Project's potential positive effect on public safety during operations is assessed as being of low to high magnitude, depending on the effectiveness of design elements and mitigations aimed at reducing collisions. The effect is local in extent and of long-term duration and does not require reversion during the operations phase. The potential for safety improvements is continuous.

Sensory disturbances (e.g., noise, odour, dust, changes to the visual aesthetic) and traffic delays as a result of Project construction will be partially mitigated by construction management practices and equipment maintenance but will still represent nuisances for visitors. This residual effect is of moderate magnitude, given the importance of the natural environment of YNP to visitors. The effect is local to the portion of construction activities along the TCH within YNP, will occur frequently during the construction period, and would be reversible following the cessation of construction activities. During operation, several infrastructure upgrades are expected to yield a positive residual effect on visitor experience. These upgrades do not include the installation of new visitor use areas, but rather enhance existing parking and provides for safer pedestrian access. The effect is considered of moderate magnitude given ability of the upgrades to influence visitor learning and satisfaction, localized but continuing into the long term (operations period).

Permanent removal of sites of visitor use are limited to closure of the Finn Creek day use area and Kicking Horse Pass Rail Bridge visitor viewpoint area along with the removal of a small portion of the anthropogenic wetland near the YNP Visitor Center in Field. Construction management measures will be in place to limit the visual disturbance to users of the wetland. Given the highly limited area of permanent disturbance, relative to the remaining portion of the wetland and its banks available for use, the magnitude of this effect is negligible and localized.

Prediction confidence related to the assessment of potential Project effects on safety is low, given the high level of uncertainty around the occurrence or severity of accidents. It is not possible to effectively predict with certainty the magnitude or likelihood of accidents during construction, or the realization of potential Project benefits associated with enhanced road safety during operation. Prediction confidence in the assessment of the Project's effect on visitor learning and satisfaction is considered high, as sensory disturbances and traffic delays are certain to occur during Project construction.

Archaeological Resources

The archaeological impact assessment (AIA) for this Project was conducted under Parks Canada Research and Collection Permits YNP-2018-29599 and YNP-2019-33778, issued by the LLYK Field Unit. The 2018 fieldwork was completed between 20 August and 29 November and the 2019 fieldwork was completed between 09 September and 09 October.

For the AIA, the VCs consist of archaeological sites that adhere to PCA's criteria for cultural resources of national historic significance and cultural resources of other heritage value. Two Archaeological Overview Assessments were prepared for this Project, one by PCA listing the known archaeological sites in the vicinity of the Project and outlining the required tasks and one by Wayne Choquette, an expert in the archaeology of the southern interior of British Columbia, that described and delineated areas with the potential to contain precontact Indigenous archaeological sites. A historical essay on the TCH corridor was prepared by PCA historian Meg Stanley prior to fieldwork.

In the *Guidelines for the Management of Archaeological Resources*, PCA outlined the criteria for evaluating archaeological resources to determine the level of cultural resource importance represented. Resources "directly related to the reason of designation of a National Historic Site" are considered to be cultural resources of national historic significance. Other archaeological resources are evaluated relative to several criteria in the categories of Physical Value, Associative and Symbolic Value, Scientific and Research Value and Public Value. The criteria include the nature of the physical archaeological evidence, the integrity of the resource, the association of the resource with recognized persons and cultural traditions, the age, rarity and representativeness of the resource, and the interpretive potential of the resource, among other things.

Since the Kicking Horse Trail is considered a cultural landscape, this archaeological site will be evaluated with respect to its archaeological value as well as its characteristics and value as a cultural landscape. According to Parks Canada's *Standards and Guidelines for the Conservation of Historic Places in Canada*, cultural landscapes need to be assessed with reference to 11 categories of evidence, where applicable:

- evidence of land use;
- evidence of traditional practices;
- land patterns;
- spatial organization;
- visual relationships;
- circulation;
- ecological features;
- vegetation;
- landforms;
- water features; and
- built features.

In order to comply with part of PCA's mandate to protect cultural heritage, the recorded archaeological sites were evaluated relative to PCA's criteria. Of the 76 archaeological sites recorded or revisited, 27 will be directly affected by Project development, one may be affected indirectly and two are very close to the development area. Of the 30 sites that will be affected directly or indirectly, eight are not considered valuable cultural resources and no further work is recommended in relation to Project development. Further investigation is recommended at 13 of 17 sites considered to be cultural resources of other heritage value and four of the five sites considered to be cultural resources of national historic significance. This additional investigation will be undertaken to mitigate Project effects through the collection of data for future analysis and interpretation. This will conserve the archaeological resources by preserving data that make the valuable cultural resources.

Once mitigation is completed for the Project, residual effects to Archaeological resources associated with the Project will be negligible. Positive residual effects may remain for archaeological sites where the mitigative strategies of additional investigations are applied due to the acquisition of additional data.

Confidence in the assessment is high and rests on the extent of survey coverage of the Project footprint in order to ensure that archaeological sites that may be affected have been recorded. The AIA targeted both precontact Indigenous archaeological resources and postcontact resources. No Indigenous sites were found during this AIA. The noted locations of two previously recorded precontact Indigenous sites consisting of isolated artifact finds were revisited but no evidence of these sites was observed. Thirty-six previously recorded postcontact sites were revisited and 38 additional postcontact sites were recorded.

Traditional Land Use and Indigenous Values

The Ktunaxa Nation and Shuswap Indian Band each undertook their own independent assessments for the Project. Each of the Indigenous groups had discretion over the approach, content and writing of their sections so that their respective sections reflect their outlook regarding their interests and potential adverse impacts of the project on their interests. The assessments also identify broader, park-level concerns, which are outlined in their respective assessments. Parks Canada continues to consult with Indigenous groups to discuss issues and concerns, potential project effects and proposed mitigation measures and other interests.

The Ktunaxa Nation Council prepared a *Rights, Use, and Interests Study for Parks Canada's TransCanada Highway Twinning Phase IVB Project (Yoho National Park)* (Firelight, 2019). The full report can be viewed in the DIA; an excerpt from their report is provided below.

> *The Project is located within YNP and the Ktunaxa traditional land district of ʔaknuqƚuƚaṁ ʔamakʔis (home or land of Eagle). Ktunaxa oral and archival history indicate that prior to and following 1846, Kicking Horse pass, and the more northern Howse Pass, were regular Ktunaxa routes used to travel across the Rocky Mountains to trade or hunt buffalo along the eastern slopes. Impacts on Ktunaxa rights in what is now Yoho National Park have been ongoing and significant for over 130 years, beginning in 1885 when the Canadian Pacific Railway (CPR) route through Kicking Horse Pass was completed. Banff, Glacier and Yoho national parks were created a year later in 1886 under Prime Minister John A. MacDonald. With the railway, and subsequent highway, the area became a major travel corridor and gateway into*

> *ʔamakʔis Ktunaxa for Euro-Canadian settlers resulting in increased tourism, privatization, and Ktunaxa exclusion. Ktunaxa harvesting rights, and rights of access, are not recognized in national parks. As a result of this policy, Ktunaxa title and rights over a large portion of ʔamakʔis Ktunaxa continue to be infringed.*
>
> *While the Project area has high ecological value, the overall baseline for Ktunaxa rights in YNP is severely impacted due to YNP management and operation of the existing highway, and Ktunaxa rights are highly vulnerable to further impact as a result. The proposed Project will result in adverse effects that will add to and interact with existing significant impacts on Ktunaxa rights, use and interests. Absent mitigation, the Project is likely to result in significant adverse effects given the context of already significant impacts on Ktunaxa title and rights in the Project area. Adverse Project effects are anticipated across all Ktunaxa sectors, including impacts on traditional use and access to lands and resources, archaeological and heritage resources within the Kicking Horse Valley, continued exclusion of traditional knowledge, language and culture along the corridor, and impacts to ecological values including fisheries and wildlife connectivity. Alternately, with implementation of KNC mitigation and related measures, the Project has the potential improve Ktunaxa access, increase Ktunaxa use, and include Ktunaxa language, knowledge and stewardship, as well as economic and social participation, in construction and operation of the Project, and in managing ongoing impacts of the TCH through Yoho National Park and adjacent areas of ʔamakʔis Ktunaxa.*

The Shuswap Indian Band (SIB) prepared a Cultural Heritage Assessment and a Traditional Ecological Overview Assessment (phase 1) for the Project. An excerpt of the reports is provided below. Portions of the reports can be viewed in the DIA.

> *The Trans-Canada Highway runs through Secwépemcúĺecw and further expansions has the potential to impact Secwépemc title and rights, land use and ecological features as discussed in the Cultural Heritage Assessment. Yoho National Park (YNP) was established in 1886 to protect areas and resources within the Rocky Mountain Natural Region. Recognizing the wide-ranging benefits of such protections, it is important to note YNP also represents displacement and restricted use of 1,313 km2 of land and resources within SIB traditional territory. The resulting impacts on cultural integrity, practice and resource are significant, particularly when considering broader, regional impacts on Secwépemc communities and interests.*
>
> *An environmental resource management concepts paper for the project was completed to convey Secwépemc perspectives. It is the first of two phases under a Traditional Ecological Overview Assessment (TEOA) and provides a high-level overview of project related effects, culturally valued resources (CVR), traditional ecological knowledge (TEK) and recommendations for environmental resource management. Indigenous Knowledge is combined with Western Science to strengthen understandings, promote learning and support decision making. It provides a more rigorous approach and knowledge than would be achieved under either approach alone. Opportunities for enhanced collaboration between SIB and Parks Canada (PC) are highlighted to support this complimentary.*

Cultural Landscapes

A *Heritage Study of TCH Transportation Corridor Cultural Landscapes within Yoho* (GC 2017) was undertaken to identify the potential heritage value of the TCH transportation corridor landscape. The report made a number of recommendations relevant to the Project. The mitigations endorsed for the twinning include completion of an archaeological recording of extant portions of the Kicking Horse Trail grade (Wood 2020), digitizing the Yoho Man Disturbed Inventory binders and completing photographic documentation of the current landscapes associated with the highway. These efforts to preserve information on the current and historic state of YNP are in progress and are expected to be complete by summer 2020. Once mitigation is completed for the Project, residual effects to Cultural Landscapes associated with the Project will be negligible.

Air

Air quality and climate change were identified as the VCs for this discipline. Air quality is defined as the concentration of pollutants in the ambient air. The indicators used to assess the effects of the Project on air quality include changes in concentrations of pollutants in the ambient air as measured against ambient air quality criteria, and changes in the emissions of greenhouse gases (GHG). Changes to these attributes through the duration of the Project can be qualitatively assessed.

Project emissions mainly, produced by the combustion of diesel by the construction fleet and activities, for which air quality standards apply are expected to be limited primarily to nitrogen oxides (NO_X), carbon monoxide (CO), and particulate matter nominally smaller than 2.5 microns in aerodynamic diameter ($PM_{2.5}$). As ultra-low sulphur diesel (ULSD) will be used by the fleet, sulphur dioxide (SO_2) emissions are expected to be minimal. GHGs will also be emitted by the construction fleet and activities.

Project air emissions will begin with the start of construction but will end and return to baseline conditions when construction ends. As such, the Air component of the Project DIA is focused on effects on air quality during the construction phase; as effects during other phases of the Project are expected to be less than those predicted for the construction phase. The LSA contains no major industry and minimal secondary sources of air quality emissions (i.e., primarily highway vehicle traffic and occasional parks infrastructure).

The construction fleet and associated equipment, such as portable generators and asphalt production will combust diesel fuel and will emit criteria air compounds (CACs) NO_2, CO, $PM_{2.5}$, and GHGs. Construction activities will also generate fugitive dust, and volatile compounds will be emitted during asphalt application. After construction ends, air pollutant emissions will be from the same sources as existed prior to the Project, at approximately the same levels. Emissions released during maintenance would be similar in nature, but at a lower intensity and frequency than during construction. Effects on Project air quality are not expected to significantly affect other Project VCs.

Air pollutants emitted by construction activities will disperse rapidly with distance from the disturbance footprint and are predicted to approach baseline levels within 200 m to 1000 m. Short-duration events of fugitive dust emissions from exposed soils and gravel or clusters of diesel equipment could increase concentrations of CACs near the Project, but these are unlikely to persist long enough to result in exceedances of the air quality criteria. As the baseline ambient air quality conditions indicate clean air, the

airshed in the LSA has a high capacity to attenuate air pollutants before ambient air quality criteria are exceeded. The Project will not be a major emitter of air pollutants, so approaching ambient air quality criteria for any length of time or spatial extent is unlikely. "Hotspots" such as a dusty stretch of construction can be mitigated with the application of water, no-idling rules and well-maintained equipment can limit fuel combustion emissions.

The Project is expected to contribute very little to provincial and federal GHG emission totals. The Canadian Environmental Assessment Agency has stated in the past, "unlike most project-related environmental effects, the contribution of an individual project to climate change cannot be measured". Project effects to air during the operation and maintenance phase are expected to be less than during the construction phase, since the Project is not expected to result in substantial increases to traffic volumes on the TCH and the equipment fleet required for road maintenance will be much smaller than the Project construction fleet.

The magnitude of air emissions is low during times of construction, and negligible during other times. Exceedances of the British Columbia Ambient Air Quality Objectives and Canadian Ambient Air Quality Standards due to Project emission sources are not expected, either alone or cumulatively. Project air emission sources (construction equipment) will mainly be constrained to a short stretch of the TCH, and only specific components of the construction fleet will be operating at any one time. Mitigation and best practice measures will be followed to minimize Project emissions. As soon as construction ceases, air emissions from the Project construction will cease excepting minimal emissions during maintenance activities, and changes to pollution concentrations in the LSA will return to baseline conditions. No further effects to air quality or climate change are expected, and no residual effects on air quality or climate change are expected from the Project.

Although there is uncertainty in estimating specific air pollutant concentrations generated by the construction of the Project, the overall prediction confidence for the air component of the DIA is high.

Noise

Noise and vibration were identified as the VCs for this discipline. Construction of the Project will require use of mobile equipment, such as dozers, graders, and trucks. Construction of the Project will also require use of stationary equipment, such as generators, rock crushers, and pile drivers. For the duration of the Project construction phase, noise emissions from mobile and stationary construction equipment will increase noise levels in areas where this equipment operates. Construction of the Project will also require explosive blasting, which can increase vibration levels in areas surrounding the blast sites.

To mitigate potential effects to the noise levels VC, PCA will limit construction activities to the daytime period (i.e., 7 am to 10 pm), where practical. PCA will also require that the contractor(s) selected for Project construction make use of heavy equipment fitted with well-maintained muffler systems. To mitigate potential effects to the vibration levels VC, PCA will limit explosive blasting to the daytime period (i.e., 7 am to 10 pm), where practical. PCA will also avoid blasting within 300 m of buildings and occupied visitor facilities, where practical. The Project will avoid explosive blasting within 300 m of buildings and occupied visitor facilities, where practical.

Taking the highest magnitude effect at any receptor as representative of the Project as a whole, the overall magnitude of Project effects to the noise levels VC will be high, meaning Project construction will generate a disturbing level of noise at some receptors during periods when construction activities occur nearby. As well, the overall magnitude of Project effects to the vibration levels VC will be moderate, meaning Project construction will not generate vibration levels in excess of threshold limits. However, because the effects occur infrequently, last for a very short duration, and are reversible, a low incremental residual effect to both noise and vibration levels is predicted for the construction phase of the Project.

Although there is uncertainty and variability in the specific noise level or vibration level that will be observed at a given receptor, there is a high degree of confidence in the residual effect classification for the noise levels VC and vibration levels VC for the Project.

Cumulative Effects

For the purposes of this DIA, cumulative effects are defined as the sum of all natural and human-induced influences on each VC within YNP as a condition prior to development of the CPR, until completion of the Project. A cumulative effects assessment was only completed for VCs for which Project related residual effects were predicted to have an environmental consequence greater than negligible magnitude. Cumulative effects were assessed at the regional scale. Both quantitative and qualitative approaches were used to conduct the cumulative effects assessment, depending on the availability of data for each VC.

Existing/current disturbance and activities associated with human development in the region include:

- Trans-Canada Highway and other roads in the region and associated existing traffic;
- Historic roads and trails;
- Canadian Pacific Railway;
- Boulder Compound;
- Mt Vaux storage area (rock dump);
- Yoho Pit;
- West Gate pullout;
- Banff Boundary welcome station;
- Yoho Ranch;
- Residential and commercial development within Field;
- Tourism infrastructure including:
  - Spiral Tunnels Hill,
  - Takakkaw Falls, Cathedral Mountain Chalets and the Yoho Valley;
  - Emerald Lake and the Natural Bridge;
  - Wapta Falls;
  - Burgess Shale Fossil Beds;

  - Finn Creek;
  - Faeder Lake;
  - Great Divide Lodge; and
  - Lake O'Hara and associated parking lot;
- Designated hiking trails and associated parking lots ; and
- Designated campsites, including Kicking Horse, Monarch, Takakkaw Falls and Hoodoo Creek. At the time of this DIA preparation, there is a recognition that the Hoodoo Creek campsite may be upgraded in the future. It is assumed that any campground upgrades would occur on the existing disturbed campsite footprint.

A comprehensive cumulative effects assessment was achieved by adding the Project and other reasonably foreseeable developments to the existing condition to predict a future outcome for VCs in the region, assuming all the expected future changes happened together.

In addition to the projects noted above, CPR may twin the railway line through the park. While this project has the potential to occur in the future, there is no current plan or timeline for twinning of the rail line, and as a result it has not been included in the cumulative effects assessment.

Terrain and Soils

The cumulative effects of the Project on terrain and soils acting in conjunction with other existing and proposed development in YNP will result in no anticipated change to terrain stability but an incremental loss of soils in the area. Given the limited amount of disturbance and application of appropriate mitigation measures, residual effects are not expected to result in potential adverse residual effect to terrain and soils. As a result, no potential adverse cumulative effects are expected for Terrain and Soils.

Vegetation and Wetlands

Cumulative effects resulting from the Project in conjunction with existing and proposed development within YNP will result in the additional incremental loss of existing vegetation. The current and proposed projects require limited levels of vegetation clearing, and any areas decommissioned (e.g., due to trail or highway relocation) or temporary work areas will be reclaimed and restored. Listed plant species and wetland communities are expected to be avoided. While mitigation measures will be implemented, there will likely be an incremental increase in the presence of invasive species within YNP due to exposure of soils, utilization and expansion of existing disturbances, and the challenges of managing activities of multiple contractors associated with the additional projects.

Overall cumulative effects to vegetation and wetlands communities will be difficult to adequately quantify given that revegetation, restoration and regeneration associated with other projects within YNP have not been considered as part of this DIA. However, cumulative effects are predicted to be minor in magnitude and localized in extent, in consideration of planned reclamation and restoration, as part of the Project. Duration associated with Project construction effects will be short term while those associated with operations will be long term.

Wildlife

The cumulative effects assessment for wildlife was limited to a qualitative analysis of the combined effects of current human disturbance and disturbances associated with the TCH project and planned and reasonably foreseeable projects. A qualitative assessment was conducted since, in most cases, the assessments of residual effects of the Project on wildlife were qualitative assessments as well, relying on the best science for the LSA.

Over time, traffic on the TCH is expected to increase at about 2% per year, with or without twinning. The incidence of wildlife mortality along the TCH as a whole is expected to increase as a result. However, fencing of the TCH in BNP has dramatically reduced ungulate mortality and has also led to reduced carnivore mortality. Improvements to the fencing such as use of a buried apron to deter animals from digging under the fence have reduced carnivore mortality further than on previous sections of the TCH. Similar reductions to WVCs involving carnivores are expected within the RSA, with the continued construction of fencing.

Increases in human use of the National Parks within the RSA and beyond will likely result in increased human-wildlife conflicts. This could lead to an increase in wildlife habituation and increased risk of adverse wildlife management actions. Increased human-wildlife conflicts typically result in increased risk of human-caused wildlife mortality stemming from management actions. However, YNP and other mountain parks have dedicated teams that work to reduce human-wildlife conflicts in the parks and deliver education programs designed to reduce negative human-wildlife interactions. Human-wildlife conflicts within YNP and other mountain parks will likely result in far fewer wildlife mortality events compared to the number caused by collision with vehicles on unmitigated sections of roadways or collisions with trains along railways in the region.

The CPR is a major contributor to wildlife mortality for species such as grizzly bear, wolves, and elk within Banff and YNP. Although the railway is running near or at capacity currently, any future changes to rail traffic that increase the risk of mortality for wildlife in YNP will affect the viability of these species. The same can be said for railways through the Bow Valley, Crowsnest Pass to the south and Jasper National Park to the north.

Thinning of the forest for fire control, or "Fire Smarting" has the potential to increase the attractiveness of thinned areas to grizzly bears, black bears, some small mammals and species of birds, and ungulates. Removal of tree cover, whether through natural means such as fire or artificial means such as thinning or clearing, results in a greater abundance of grasses, forbs and shrubs that can attract wildlife. Forest thinning near the Community of Field and other PCA infrastructure has likely resulted in a proliferation of buffaloberry and can provide a source of human-bear interactions during the berry season.

When all human-caused mortality sources are summed within the RSA, the cumulative total will likely have a positive effect on the population viability of some wildlife species in YNP, such as grizzly bear, as compared to after the CPR and TCH were originally constructed. Despite the predicted positive effects created by some aspects of the current Project, small negative effects operating at the regional scale are also expected. The magnitude of negative effects operating at the regional scale are expected to be higher than the anticipated positive effects on wildlife populations in YNP associated with the Project since the development of the CPR.

Currently, wildlife movement and habitat connectivity in YNP is adversely affected by the TCH and the CPR. Even though the highway is not physically fenced, the speed and volume of highway traffic has likely created perceived barriers to movement and limited the frequency of successful crossing events for some species. As traffic volumes increase, it is plausible that the TCH could effectively become a complete barrier to movement for some species, although a physical fence is not in place. The effect of traffic volume on wildlife movement likely varies by species, sex-age cohorts within species, and at the level of the individual as well. Traffic on other highways within the region likely have similar effects on wildlife movement. Increases in traffic volume will exacerbate the situation resulting in a general decline in connectivity for wide-ranging species in the mountain parks region.

Mitigation efforts over the past 30 years have essentially restored habitat connectivity and gene flow for many species across large sections of this major transportation corridor in BNP. This has been accomplished through the construction of wildlife crossing structures during highway twinning in BNP. Restoration of wildlife movement and habitat connectivity will continue to improve if twinning of the TCH continues westward and incorporates the same mitigations.

Although it is recognized that at the cumulative scale wildlife habitat availability and scarce resources will be permanently lost from the TCH and other developments, all species guilds are recognized as benefitting from wildlife crossing structures which will support movement to resources that are in many cases difficult to access within the existing conditions of YNP. This pertains to not only large ungulate and carnivores, but also to small mammals and birds as evidenced in previous monitoring studies. Crossing structures, including culverts under the TCH, will facilitate access to breeding and foraging habitats as well as to scarce resources.

The effect of the Project not proceeding or "No Project" has high adverse consequences for mortality, human-wildlife conflicts and habitat connectivity. In absence of the Project, the majority of wildlife species will sustain increased mortality rates and decreased connectivity across the TCH as traffic volumes increase. The risk of mortality associated with adverse human-bear encounters will also increase with anticipated increased human use of YNP. Wolverines and mountain goat would potentially be negatively impacted by the "No Project" option, although a lack of information regarding their population status and movement precludes a more definitive cumulative effects statement. Increased traffic volumes will increase mortality rates and reduce connectivity for passerines and western toads possibly reducing their local populations. Other species will be affected to lesser degrees.

Hydrology and Aquatic Resources

Planned projects that overlap spatially and temporally with the Project have the potential to act cumulatively to affect hydrology and aquatic resources. Site preparation and/or excavation will have the potential to act cumulatively with the Project to increase erosion and associated transport of sediment-laden runoff to waterbodies and watercourses, including the KHR. These projects will be required to follow PCA BMPs related to sediment and erosion control and all work will be conducted in adherence with permitting conditions. As such, potential cumulative effects on the aquatic environment from release of sediment from land disturbance are expected to be minor or to not interact cumulatively. Residual cumulative effects of the planned projects in combination with the Project on water quality are, therefore, predicted to be low in magnitude, localized in extent and short-term in duration.

None of the planned projects are expected to interact cumulatively with the Project to affect fish habitat connectivity as they are not expected to involve construction or replacement of culverts in watercourses or waterbodies, which can interfere with fish movement if constructed improperly. Likewise, none of the projects are expected to require in-water work and, therefore, are not expected to interact with the Project cumulatively to alter fish habitat quality and quantity.

Visitor Experience

Construction activities associated with the development, repair, or removal of existing tourism infrastructure and attractions along the proposed Project route can interact with Project construction activities to effect visitor experience in YNP. The construction contractor will be required to have a Health and Safety Management Plan and a Traffic Management Plan to mitigate these potential interactions. As a result, a negligible effect on visitor satisfaction and worker and public safety is anticipated during Project construction. A number of access point improvements are expected to have a positive effect on visitor experience along the proposed Project route, improving parking, providing safer pedestrian access, and in some cases improving infrastructure condition.

A *Heritage Study of TCH Transportation Corridor Cultural Landscapes within Yoho* (GC 2017) was undertaken to identify the potential heritage value of the TCH transportation corridor landscape. The report made a number of recommendations relevant to the Project. The mitigations endorsed for the twinning include completion of an archaeological recording of extant portions of the Kicking Horse Trail grade (Wood 2020), digitizing the Yoho Man Disturbed Inventory binders and completing photographic documentation of the current landscapes associated with the highway. These efforts to preserve information on the current and historic state of YNP are in progress and are expected to be complete by summer 2020.

Archaeological Resources

Since residual negative effects will be negligible, cumulative negative effects will also be negligible. Positive residual effects may remain for archaeological sites where the mitigative strategies of additional investigations are applied due to the acquisition of additional data because those data will augment the greater understanding of the archaeological record of YNP.

Cultural Landscapes

As noted in the *Heritage Study of TCH Transportation Corridor Cultural Landscapes within Yoho* (GC 2017), all proposed changes associated with the design of the Twinning Project have a cumulative effect on the heritage value of the TCH Transportation Corridor Cultural Landscapes, making it important to document and record the landscape before the changes. As recording of the landscape is in progress and will be complete prior to construction, cumulative effects to Cultural Landscapes will be appropriately mitigated.

Air

Residual effects were negligible during the Project effects assessment. As a result, cumulative effects to air are not anticipated.

Noise

Vehicular traffic on the TCH and train traffic on the CPR line are expected to remain the dominant noise sources in the Project area for the duration of the Project. Because small-scale future activities are not expected to materially affect noise levels or vibration levels in the Project area, cumulative effects to noise are not anticipated.

Monitoring, Future Requirements and Environmental Management Plans

An overall Project Environmental Monitoring Plan (EMP) will be developed during the detailed design phase to provide a summary of future requirements and monitoring programs. Monitoring programs are intended to document the effectiveness of mitigation measure implementation, identify unanticipated potentially adverse effects and determine the success of reclamation activities, including provision of feedback for additional mitigation, if necessary.

Terrain and Soils

In areas of problem soils or where revegetation conditions perform poorly compared to adjacent areas, a soil monitoring program will be established to determine whether soil conditions are a limiting factor for revegetation. Measurements related to soil can include:

- depth of soil cover;
- soil quality sampling (texture, organic matter percentage, moisture);
- soil compaction testing with respect to root growth restriction; and
- soil chemical analysis (pH, electrical conductivity, base saturation) relating to plant nutrition and growth.

These monitoring parameters will be used to guide revegetation strategies and planning successional trajectories using principals of adaptive management.

Vegetation and Wetlands

A monitoring program will be developed and implemented to evaluate the success of mitigations applied to preserve and create vegetation and wetland community habitat. This monitoring program will include:

- determining performance criteria to evaluate plant species establishment and successional trajectory;
- verifying surface and subsurface water movement;
- documenting vegetation community composition;
- documenting use of habitat by wildlife species; and
- using monitoring data within the framework of an adaptive management program to maximize the effectiveness of reclamation efforts, as appropriate.

If mitigation for listed plants is required, a monitoring plan will be implemented to inform success of applied mitigation measures and enact adaptive management as needed.

Monitoring of construction sites and reclamation sites for invasive species will inform success of applied mitigation measures and enact adaptive management as needed. Monitoring programs will meet the objectives in the *Lake Louise, Yoho and Kootenay Field Unit: Integrated Invasive Plant Management Plan 2018 - 2022* and will be conducted for a minimum of 5 years after completion of construction.

Wildlife

Ecological monitoring surveys for a variety of wildlife in YNP will continue following the completion of twinning activities to assess wildlife population dynamics and habitat use. Survey locations will include wetland habitat created during the Project as compensation for habitat loss.

Monitoring of new and existing wildlife crossing structure effectiveness will continue and will include wildlife use of crossing structures, population-level monitoring for wide-ranging rare species and human use of crossing structures and wildlife reactions to this use. Wildlife fencing will also be monitored post-construction to verify the integrity of the fence and the buried apron. The frequency of WVCs will continue to be monitored during construction and operations to determine the efficacy of mitigations.

Monitoring of the Ogden mineral lick will provide valuable information to determine potential Project effects to this scarce resource and the efficacy of Project mitigations.

Monitoring plans will be developed to determine effectiveness of restoration projects, including wetland compensation, and will include documenting use of habitat by wildlife species, including birds, large mammals and amphibians.

Aquatic Resources

In order to ensure aquatic resources are adequately protected, an environmental monitor will be on-site during instream construction at waterbody and watercourse crossings or within identified encroachment areas to oversee implementation and effectiveness of the environmental controls and mitigation measures. A *TSS/Turbidity Monitoring Program* will be implemented at select crossings and locations to identify if further mitigation is required for in-water construction. Post construction monitoring will provide feedback on the effectiveness of highway and waterbody and watercourse crossing design features and mitigation. In addition, water crossing structures will be inspected regularly to identify and remove any blockages that could alter hydrology or channel morphology or interfere with fish passage.

Archaeological Resources

Once strategies are applied to mitigate the effects of the Project to valued components, negative residual effects will be negligible. Should previously unidentified palaeontological, archaeological or historical resources be encountered during construction, a Chance Find protocol will be initiated and work will be suspended in the area of the discovered artifact or resources and the Parks Canada archaeologist will be contacted to determine the appropriate course of action required to proceed.

Visitor Experience

Visitor safety will be monitored by tracking vehicle-wildlife collisions along the TCH and incidences of human-wildlife conflicts along the TCH as reported by users. Road conditions will also be monitored regularly throughout the year to determine the need for repairs.

Air

As no anticipated residual effects to air quality are expected from the Project and any short term air quality effects are reversible once construction ceases, no monitoring or follow-up requirements with respect to air quality are anticipated.

Noise

As noise emissions and noise effects from highway construction activities are well understood, and the noise effects assessment completed for the Project predicts a low incremental residual effect to both the noise levels VC and the vibration levels VC, monitoring of noise levels and vibration levels is not anticipated.

Environmental Management Plans

Environmental Management Plans for the Project will be developed in advance of construction and will be incorporated within the Project's overall EPP. The EPP will outline how the successful contractor(s) will meet the environmental mitigations outlined in the DIA including within specific EMPs. The purpose of an EMP is to provide specific actions to be carried out by the proponent to ensure mitigation measures provided in the DIA are enacted and are meeting the recommended environmental protection. EMPs that will be required for this project include:

- Erosion and Sediment Control Plan;
- Instream Works Plan;
- Invasive Species Management Plan;
- Listed Species Management;
- Restoration Plan; and
- Spill Response and Waste Management Plan.

Construction Management Plans

A number of additional construction management plans have been included to address mitigations proposed by the Visitor Use and Enjoyment components, as well as for worker safety. These include:

- Traffic Management Plan;
- Health and Safety Management Plan;
- Communication Plan;
- Avalanche Safety Plan; and
- Wildfire Management Plan.