



September 28, 2016

TRANSCANADA HIGHWAY IMPROVEMENT PROJECT, GLACIER NATIONAL PARK

Fish Habitat Assessment, DFO Self-Assessment and Detailed Mitigations Summary

Submitted to:

Highway Engineering Services
Mount Revelstoke and Glacier National Park Field Unit
Parks Canada Agency

REPORT

Report Number: 1654325_RP0002_Rev B

Distribution:

Trevor Kinley and Mike Stefanyk, Parks Canada Highway
Engineering Services
Krista Royle, Mount Revelstoke and Glacier National Park
Simon Armstrong-Bayliss, McElhanney





Table of Contents

| | |
|---|----------|
| 1.0 INTRODUCTION | 1 |
| 1.1 Project Understanding | 1 |
| 1.2 Objectives | 2 |
| 2.0 METHODS | 3 |
| 3.0 RESULTS | 5 |
| 3.1 Crossings – No Watercourse/Waterbody or Fish Habitat | 12 |
| 3.1.1 TCH km 24.15 (TCHGlacier_19.6)..... | 12 |
| 3.1.2 TCH km 27.9 (TCHGlacier_15.8)..... | 13 |
| 3.1.3 TCH km 28.5 (TCHGlacier_15.1)..... | 14 |
| 3.2 Crossings – Watercourse/Waterbody with no Fish Habitat..... | 14 |
| 3.2.1 TCH km 20.94 (TCHGlacier_22.8) and km 20.91 | 15 |
| 3.2.2 TCH km 22.05 (No named culvert/stream)..... | 16 |
| 3.2.3 TCH km 22.15 (TCHGlacier_21.6)..... | 17 |
| 3.2.4 TCH km 23.4 (TCHGlacier_20.7)..... | 18 |
| 3.2.5 TCH km 23.6 (TCHGlacier_20.2)..... | 19 |
| 3.2.6 TCH km 23.84 (TCHGlacier_19.9)..... | 20 |
| 3.2.7 TCH km 23.94 (TCHGlacier_19.8)..... | 21 |
| 3.2.8 TCH km 24.9 (TCHGlacier_18.8) and km 25.0 | 22 |
| 3.2.9 TCH km 25.1 (TCHGlacier_18.6)..... | 23 |
| 3.2.10 TCH km 25.25 (TCHGlacier_18.5)..... | 24 |
| 3.2.11 TCH km 27.25 (TCHGlacier_16.4)..... | 25 |
| 3.2.12 TCH km 27.5 (TCHGlacier_16.2)..... | 26 |
| 3.2.13 TCH km 27.6 (TCHGlacier_16.1)..... | 27 |
| 3.2.14 TCH km 28.0 (No named culvert/stream)..... | 28 |
| 3.2.15 TCH km 28.7 (TCHGlacier_15.0)..... | 29 |
| 3.2.16 TCH km 28.8 (TCHGlacier_14.8)..... | 30 |
| 3.3 Crossings – Watercourse/Waterbody with Fish Habitat..... | 31 |
| 3.3.1 TCH km 20.76 (TCHGlacier_23.0)..... | 31 |



3.3.2 TCH km 21.06 (Hermit Creek) 32

3.3.3 TCH km 21.25 (TCHGlacier_22.5)..... 34

3.3.4 TCH km 22.3 (Connaught Creek, TCHGlacier_21.5)..... 35

3.3.5 TCH km 23.2 (TCHGlacier_20.6)..... 37

3.3.6 TCH km 24.6 (TCHGlacier_19.2)..... 38

3.3.7 TCH km 24.8 (TCHGlacier_19.0)..... 40

3.3.8 TCH km 25.7 (TCHGlacier_18.0)..... 41

3.3.9 TCH km 25.8 (TCHGlacier_17.9)..... 43

3.3.10 TCH km 27.1 (TCHGlacier_16.6)..... 44

4.0 RECOMMENDATIONS FOR MEASURES AND STANDARDS TO MITIGATE SERIOUS HARM TO FISH..... 45

4.1 General Mitigation Measures Included in the BIA..... 45

4.2 Additional Site-Specific Mitigation Measures for Crossings with no Watercourse/Waterbody and no Fish Habitat 47

4.3 Additional Site-Specific Mitigation Measures for Crossings with a Watercourse/Waterbody but no Fish Habitat 47

4.4 Additional Site-Specific Mitigation Measures for Crossings where a Watercourse/Waterbody with Fish Habitat is Present 48

5.0 DFO SELF-ASSESSMENT..... 49

5.1 The *Fisheries Act* and Serious Harm Determination..... 49

5.2 Self-Assessment Process..... 49

5.2.1 No Watercourse or Waterbody Present 50

5.2.2 Watercourse or Waterbody Present with No Fish Habitat Present at the Crossing..... 50

5.2.3 Watercourse or Waterbody Present with Fish Habitat Present at the Crossing 53

6.0 CONCLUSION 55

7.0 CLOSING..... 55

8.0 REFERENCES..... 56

TABLES

Table 1: Summary of in situ Water Quality Parameters at TCH km 21.06 (Hermit Creek) 33

Table 2: Summary of in situ Water Quality Parameters at TCH km 22.3 (Connaught Creek) 35

Table 3: Summary of in situ Water Quality Parameters at TCH km 23.2 (TCHGlacier_20.6)..... 37

Table 4: Summary of in situ Water Quality Parameters at TCH km 24.6 (TCHGlacier_19.2)..... 39



| | |
|--|----|
| Table 5: Summary of in situ Water Quality Parameters at TCH km 24.8 (TCHGlacier_19.0)..... | 40 |
| Table 6: Summary of in situ Water Quality Parameters at TCH km 25.7 (TCHGlacier_18.0)..... | 41 |
| Table 7: Summary of in situ Water Quality Parameters at TCH km 25.8 (TCHGlacier_17.9)..... | 43 |
| Table 8: Summary of in situ Water Quality Parameters at TCH km 27.1 (TCHGlacier_16.6)..... | 44 |
| Table 9: List of Crossings with Watercourses or Waterbodies Present but No Fish Habitat Present..... | 50 |
| Table 10: Summary of Self-Assessment Process for Crossing Locations with a Defined Watercourse or Waterbody but No Fish Habitat Present..... | 52 |
| Table 11: Listing of Crossings with Watercourses or Waterbodies Present but No Fish Habitat Present..... | 53 |
| Table 12: Summary of Self-Assessment Process for Crossing Locations with a Defined Watercourse or Waterbody and Fish Habitat Present..... | 54 |

FIGURES

| | |
|--|----|
| Figure 1: Aquatic Assessment Field Mapping (TCH km 20.6 to km 23.3)..... | 6 |
| Figure 2: Aquatic Assessment Field Mapping (TCH km 23.3 to km 23.9)..... | 7 |
| Figure 3: Aquatic Assessment Field Mapping (TCH km 23.9 to km 25.5)..... | 8 |
| Figure 4: Aquatic Assessment Field Mapping (TCH km 25.5 to km 27.5)..... | 9 |
| Figure 5: Aquatic Assessment Field Mapping (TCH km 27.5 to km 28.5)..... | 10 |
| Figure 6: Aquatic Assessment Field Mapping (TCH km 28.5 to km 29.8)..... | 11 |
| Figure 7: TCH km 24.15 (TCHGlacier_19.6) – Crossing on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)..... | 12 |
| Figure 8: TCH km 27.9 (TCHGlacier_15.8) – Crossing on downstream, westbound side taken in April 2016 (left) and at the same location in June 2016 (right)..... | 13 |
| Figure 9: TCH km 28.5 (TCHGlacier_15.1) – Ditchline on upstream, eastbound side of TCH (left) and downstream below the culvert outlet on the westbound side (right)..... | 14 |
| Figure 10: TCH km 20.94 (TCHGlacier_22.8) – Watercourse on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)..... | 15 |
| Figure 11: TCH km 22.05 (No named culvert/stream) – Watercourse on upstream, westbound side looking upstream at the two channels (left) and looking downstream where these two channels meet and go through the culvert inlet (right)..... | 16 |
| Figure 12: TCH km 22.15 (TCHGlacier_21.6) – Watercourse on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)..... | 17 |
| Figure 13: TCH km 23.4 (TCHGlacier_20.7) – Watercourse on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)..... | 18 |
| Figure 14: TCH km 23.6 (TCHGlacier_20.2) – Watercourse on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)..... | 19 |
| Figure 15: TCH km 23.84 (TCHGlacier_19.9) – Poorly-defined watercourse on upstream, westbound side (left) and defined watercourse downstream below the culvert outlet on the eastbound side (right)..... | 20 |
| Figure 16: TCH km 23.94 (TCHGlacier_19.8) – Watercourse on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)..... | 21 |



Figure 17: TCH km 24.9 (TCHGlacier_18.8) – Watercourse on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)22

Figure 18: TCH km 25.1 (TCHGlacier_18.6) – Watercourse on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)23

Figure 19: TCH km 25.25 (TCHGlacier_18.5) – Watercourse on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)24

Figure 20: TCH km 27.25 (TCHGlacier_16.4) – Watercourse on upstream, eastbound side (left) and downstream below the culvert outlet on the westbound side (right).....25

Figure 21: TCH km 27.5 (TCHGlacier_16.2) – Watercourse on upstream, eastbound side (left) and armoured section downstream below the culvert outlet on the westbound side (right)26

Figure 22: TCH km 27.6 (TCHGlacier_16.1) – Watercourse on upstream, eastbound side (left) and downstream below the culvert outlet on the westbound side (right)27

Figure 23: TCH km 28.0 (No named culvert/stream) – Overland flow channels on downstream, westbound side of the TransCanada Highway looking upstream towards the highway (right) and downstream towards the Illecillewaet River (left).28

Figure 24: TCH km 28.7 (TCHGlacier_15.0) – Hanging culvert on downstream, westbound side of TCH (left) and watercourse downstream below the culvert outlet on the westbound side (right).....29

Figure 25: TCH km 28.8 (TCHGlacier_14.8) – Hanging culvert on downstream, westbound side of TCH (left) and watercourse downstream below the culvert outlet on the westbound side (right).....30

Figure 26: TCH km 21.0 (TCHGlacier_23.0) – Watercourse on upstream, westbound side of the TransCanada Highway (left) and on the downstream side, below the culvert outlet on the eastbound side of the highway (right).....32

Figure 27: TCH km 21.08 (Hermit Creek) – Aquatic habitats on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)33

Figure 28: TCH km 21.25 (TCHGlacier_22.5) – Aquatic habitats on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)34

Figure 29: TCH km 22.3 (Connaught Creek, TCHGlacier_21.5) – Aquatic habitats of Connaught Creek on upstream, westbound side, looking upstream above the culvert inlet (left) and downstream towards the culvert inlet (right).....36

Figure 30: TCH km 22.4 to 22.5 – Aquatic habitats and inundated forest of channels flowing into Connaught Creek on upstream, westbound side, looking west at TCH km 22.4 (left) and southwest towards TCH km 22.5 (right).....36

Figure 31: TCH km 22.3 (Connaught Creek, TCHGlacier_21.5) – Aquatic habitats of Connaught Creek on downstream, eastbound side, looking upstream towards the culvert outlet (left), and downstream, below the culvert outlet (right).....37

Figure 32: TCH km 23.2 (TCHGlacier_20.6) – Aquatic habitats on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)38

Figure 33: TCH km 24.6 (TCHGlacier_19.2) – Aquatic habitats on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)39

Figure 34: TCH km 24.6 (TCHGlacier_19.0) – Aquatic habitats on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)41

Figure 35: TCH km 25.7 (TCHGlacier_18.0) – Aquatic habitats of the unnamed creek on upstream, eastbound side, looking upstream above the culvert inlet (left) and downstream towards the culvert inlet (right)42



Figure 36: TCH km 25.7 (TCHGlacier_18.0) – Aquatic habitats of the unnamed creek on downstream, westbound side, looking downstream, below the culvert outlet (left), and upstream towards the culvert outlet (right) ...42

Figure 37: TCH km 25.8 (TCHGlacier_17.9) – Aquatic habitats on upstream, eastbound side (left) and downstream below the culvert outlet on the westbound side (right).....44

Figure 38: TCH km 27.1 (TCHGlacier_16.6) – Aquatic habitats on upstream, eastbound side (left) and downstream below the culvert outlet on the westbound side (right).....45

APPENDICES

APPENDIX A

Discharge and Water Quality Parameters for Watercourses with Fish Habitat

APPENDIX B

TCH km 20.6 to km 28.3 Crossing Location Summary



1.0 INTRODUCTION

Parks Canada Agency's (PCA) Highway Engineering Services (HES) contracted McElhanney Consulting Services (McElhanney) and Golder Associates Ltd. (Golder) for the proposed TransCanada Highway (TCH) Safety Improvements Project within Glacier National Park (GNP) (the Project).

The Project will be contracted in two successive phases:

- Phase 1 associated with TCH km 24.1 to km 28.3; and
- Phase 2 associated with TCH km 20.6 to km 24.1.

Golder was contracted to conduct fish habitat assessments associated with the watercourses and proposed culvert replacements and/or extensions for both Phase 1 and 2, along the TCH. Culvert repair and replacements/extensions as well as road widening for these two phases are scheduled to occur during the 2016 and 2017 construction seasons. Golder provided aquatics professionals to conduct site-specific assessments of the fish habitat associated with locations where the Project may have impacts to fish and fish habitat and where specific culvert replacements along the TCH are proposed. In general, culvert upgrades are aimed at improving hydrological connectivity, as well as fish passage connectivity at fish-bearing watercourses.

The technical memorandum summarizes the results of the site-specific aquatic assessments, as well as to conduct a Fisheries and Oceans Canada (DFO) Self-Assessment of whether the Project will result in serious harm to fish under the *Fisheries Act*. The purpose of this report is to inform PCA and McElhanney of:

- the site-specific fish habitat conditions at each crossing location along the TCH route;
- the crossing locations that will require a DFO Request for Review; and
- recommendations for the application of DFO's measures and standards to mitigate serious harm to fish, which, in addition to those already provided in the 2016 Basic Impact Analysis (BIA) (PCA 2016a), will be incorporated into the Environmental Protection Plan (EPP).

1.1 Project Understanding

The Project involves involved the following tasks:

- Addition of a westbound travel lane on the TCH in the Rogers Pass Summit and Illecillewaet Curve area, from the current two travelling lanes to three travelling lanes, with the provision for a median barrier and standard shoulder widths for safety reasons.
- Creation of a ponding area near the Roger's Pass Visitor Information Centre (NW Quadrant).
- Formalization of the access road from the TCH westbound lanes.

As part of the highway widening, culverts along the TCH will be replaced and/or extended. The current construction design understanding is based on the Phase 1 Issued for Tender (IFT) drawings, dated May 1, 2016 (McElhanney 2016a) and Phase 2 IFT drawings, dated August 12, 2016 (McElhanney 2016b), which provides specific details on the culvert replacement and widening designs for both Phase 1 (TCH km 24.1 to 28.3) and Phase 2 (TCH km 20.6 to km 24.1). The original planned construction activities included TCH km 28.3 to km 29.1, however this was reduced to TCH km 28.3 in the IFT drawing package.



Site-specific details for certain culverts located along the Phase 2 section of the TCH were provided by McElhanney (Armstrong-Bayliss 2016a,b) in order to complete this report. In addition, the Mount Revelstoke and Glacier National Park (MRG) Field Unit are planning an Aquatic Connectivity Restoration Project on the upstream and downstream fish habitats and channels of Connaught Creek, located along the TCH at km 22.3. This watercourse crossing is identified for highway widening and replacement of the culvert during Phase 2 of the Project. The culvert design and mitigation measures that need to be employed at this site, therefore, need to align with the objectives that the MRG Field Unit has for restoring fish passage and connectivity.

A report by Streamworks Consulting Inc. (Streamworks 2014) indicated that the previous 2013 Culvert Remediation - Fish Passage Improvements project did not fully achieved the objective of restoring access to habitat areas in Connaught Creek upstream of the highway. Monitoring of fish presence/absence upstream of the Connaught Creek crossing was conducted in 2014 by Masse Environmental; however, no Bull Trout were captured or observed upstream of the culvert using electrofishing. This suggests that Bull Trout have not been able to pass through the culvert since completion of the works in 2013 (Streamworks 2014). In order to attain fish passage through the culvert, the conclusion reached by Streamworks (2014) was that it may be necessary to retro-fit baffles in the bottom of the culvert. The baffles would create velocity breaks and resting areas, allowing Bull Trout to make their way upstream (Streamworks 2014). This information was incorporated into this report as recommended mitigation.

A report by Kerr Wood Leidal Consulting Engineers and ERM (KWL 2016), which includes an assessment of Laretta and Connaught Creeks, was reviewed and the information pertaining to the Connaught Creek crossing location was incorporated into this report, specifically regarding the design requirements for the culvert and stabilization of the upstream and downstream channel. Although Laretta Creek will be included in the Aquatic Connectivity Restoration project, as well as that project's DFO Self-Assessment, this is outside of the Illecillewaet Curve Project area, and therefore, was not part of scope for this report, which focuses on the TCH widening and culvert replacement/extension within the Illecillewaet Curve Project area.

An update to the culvert design and stream stabilization around the Connaught Creek culvert was also provided by McElhanney (Armstrong-Bayliss 2016a).

1.2 Objectives

As a follow up to the initial aquatic flagging and culvert assessment work conducted by Golder for tree-clearing activities in April and May 2016, the following aquatic objectives were required:

- Identification and flagging of culverts/watercourses/waterbodies for the remaining km sections (TCH km 20.6 to km 24.1, km 25.8 to km 27.0, and km 27.9 to km 28.3) which had not yet been identified or flagged for Phase 1 and 2 of the Project construction activities.
- Detailed fish habitat assessments of watercourses with potential fish habitat, as a follow up to the BIA (PCA 2016a).
- DFO Self-Assessment review and evaluation of detailed fisheries mitigation requirements (in addition to those identified in the BIA and incorporating the site-specific fish habitat information).



2.0 METHODS

In addition to all culvert locations and watercourse crossings provided by Parks Canada along the TCH route, McElhanney provided Golder with Geographical Information System (GIS) files and drawings of the proposed brushing and grubbing limits along the TCH, widening construction footprints, as well as the locations and polygons of the culverts that are planned to be repaired, replaced or extended for Phase 1 and 2 of the Project. Field crews were provided with maps, GIS files, and coordinates needed to locate culverts and watercourse crossings where construction activities were planned for the two Phases of the Project. Based on the original TCH route, culvert replacements were proposed for km 20.8 to km 29.1 and therefore the field assessment was based on these details. However, an additional culvert replacement was subsequently identified by McElhanney at TCH km 20.76 (just east of km 20.8) which was not assessed in the June 2016 field assessment. A site visit was conducted by the MRG Field Unit on August 17, 2016 and photographs and notes on habitat conditions were provided. This information used to complete the assessment at this site.

The field assessment and flagging of the watercourses, waterbodies and culverts followed the Parks Canada Best Management Practices (BMPs) (PCA 2015), and the Special Conditions that were established during the tree-clearing activities in April and May 2016. This was done in order to identify the aquatic boundaries that require setbacks during vegetation clearing or other pre-construction activities. A waterbody is defined as “any pond or lake, or any stream or seep that flows all or part of the year” (PCA 2015).

An evaluation of fish habitat present in roadside ditches, snow/stormwater runoff channels and ephemeral streams was conducted to establish whether any of these had the potential to support fish and if these were to be included in the aquatic boundary setback flagging. According to the *Fisheries Act* (Government of Canada 1985), fish habitat means spawning grounds and any other areas, including nursery, rearing, food supply and migration areas, on which fish depend directly or indirectly in order to carry out their life processes. As described by (PCA 2015), a 30 m vegetated buffer around waterbodies should be retained during construction activities, and was used as the maximum aquatic boundary setback, for all waterbodies where fish habitat was present. This assessment and flagging task was a continuation from areas already flagged in April and May 2016. The areas that the field crew identified and flagged included any defined waterbody or watercourse, whether wet or dry at the time of the survey, and had the potential to support fish during some part of the year. If any dry or temporary flowing areas (such as roadside ditches or snowmelt drainages) were directly connected to a downstream fish-bearing watercourse/waterbody, the likelihood that disturbances of these could result in impacts to the downstream fish-bearing watercourse/waterbody, these were also flagged.

Field assessments were completed between June 7 and 12, 2016 and consisted of the following tasks:

- Culvert/watercourse/waterbody identification and flagging:
 - The crew located the coordinates of each watercourse, waterbody or culvert identified at a desktop level along the TCH.
 - The crew identified any potential watercourse, waterbody or culvert not identified at a desktop level, along the route.
 - The crew examined the watercourse/waterbody or culvert at each site under the BMPs and Special Conditions criteria and verified whether a 30 m aquatic buffer was applicable to each specific location.
 - The crew flagged the required buffer areas for a visible distance from road surface. Buffer zones were flagged in the direction of traffic flow (either on the east/west bound lane), one colour flagging tape use



for the start of the aquatic buffer (Orange Flagging Tape) and end of the aquatic buffer (Yellow Flagging Tape). These marked the boundary zones for each watercourse, waterbody or culvert that required a buffer zone.

- Detailed fish habitat assessments:
 - At all of the identified watercourse, waterbody or culvert locations, the crew determined if fish habitat was present upstream or downstream of the TCH crossing. Fish habitat potential was assessed based on the potential for water depths, flow velocities and stream gradient to be suitable for fish at any given time of the year, as well as the presence of a defined bed and banks, with or without flowing water at the time of the assessment.
 - If fish habitat was present, the crew completed habitat mapping at each site, measuring the length, width and depth and description of cover and substrate of each mesohabitat unit. Notes of potential spawning locations, substrate, and channel unit type were taken. If flowing water was present, depth and velocity profiles within representative habitat units for each habitat type encountered were measured. Routine field water quality parameters (temperature, dissolved oxygen, pH, and conductivity) were also measured at sites with water and fish habitat potential.
 - The crew assessed the condition of any culvert or crossing location where fish habitat was present, including suitability for fish passage. The area immediately surrounding the culvert was assessed to determine connectivity to downstream fish habitat, and upstream and downstream photographs were taken at each site to document any key identifying features.
 - All field data were reviewed daily for completeness and accuracy as a specific Quality Assurance (QA) and Quality Control (QC) measure, where possible, before being submitted at the end of the field program. Further QA/QC was done when plotting the data using GIS.

Based on the detailed habitat assessment, crossings were grouped into the following categories:

- crossings without defined bed and banks (i.e., drainages with overland flow, terrestrial vegetation and no channel), and therefore, no fish habitat;
- crossings where the watercourse/waterbody had defined or poorly defined bed and banks, but no fish habitat present. Although a channel or intermittent channel may be present, these watercourses/waterbodies lack suitable water depths and flows for fish (even seasonally) and/or have high gradients, such that fish cannot carry out their life processes, even on a seasonal basis. These watercourses/waterbodies may flow primarily in the spring from snowmelt and be dry at other periods in the year; and
- crossings where the watercourse/waterbody had potential fish habitat present (i.e., suitable habitat is present for fish species for all or a part of its life cycle), even on a seasonal basis.

Identified watercourse and culvert locations were mapped along with locations where fish habitat was confirmed, and field notes, data, and mapping information were compiled and presented in the results. Fish inventory and fish habitat information for specific culverts along this route of the TCH assessed in 2007 (Taylor and Helms 2007) were also incorporated into the results. Additional details for Phase 2 culverts (TCH km 20.6 to km 24.1) were provided following the field program as they became available from McElhanney (Armstrong-Bayliss 2016a,b). Additional information also included the proposed installment of two precast box culverts at Hermit Creek



(TCH km 21.06; McElhanney 2016c) and at Connaught Creek (TCH km 22.3; McElhanney 2016d). The Connaught Creek culvert design was updated as per one of the KWL recommendations (KWL 2016), including realignment and channelization upstream of the culvert inlet (Armstrong-Bayliss 2016a).

3.0 RESULTS

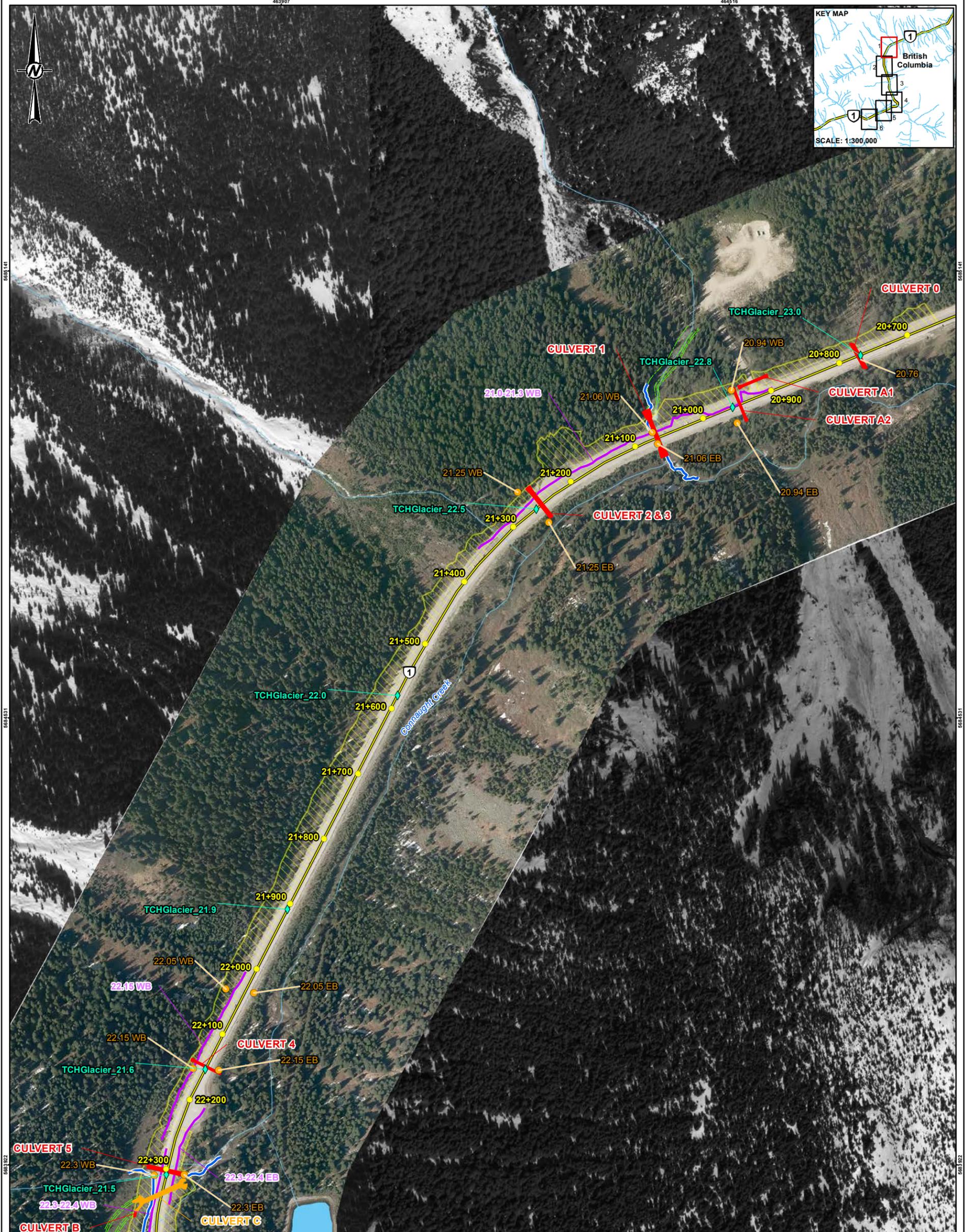
Maps indicating the locations of crossings that were visited, assessed, mapped and/or flagged along the TCH between km 20.6 and km 28.3 (Phase 1 and 2 of the Project) are provided in Figures 1 to 6. These crossing locations, including representative photos of each site, are summarized in detail below. Three crossings (TCH km 28.5, km 28.7, and km 28.8) were assessed during the field surveys, but are no longer included in Phase 1 of the Project; results of the field surveys, however, have been provided in Section 3.0 of this report, but these crossings are not included in Section 5.0.

The results are presented in the following order:

- 1) Locations of crossings where no watercourse (i.e., no defined bed and banks) or waterbody was present and no fish habitat was identified. At these sites, no additional site-specific mitigation measures from those stipulated in the BIA (PCA 2016a) are required (Section 3.1).
- 2) Locations of crossings where a watercourse or waterbody was identified (with defined bed and banks), whether flowing into a downstream fish-bearing watercourse/waterbody or not, but no fish habitat was identified at the crossing location (Section 3.2). At these sites, further site-specific mitigation measures from those stipulated in the BIA (PCA 2016a) may be required, depending on the proximity of the crossing to the downstream fish-bearing watercourse/waterbody.
- 3) Location of crossings where a watercourse or waterbody was identified and where fish habitat was present, and where further mitigation measures from those stipulated in the BIA (PCA 2016a), will be required (Section 3.3).

A summary of in situ water quality parameters and discharges measured at each watercourse where fish habitat was present is presented in Appendix A.

A summary of the crossing locations, including proposed construction activity, reduced risk timing windows, recommended mitigations and whether a DFO request for review is required, is provided in Appendix B.



LEGEND

- CROSSING ASSESSMENT LOCATION
- ◆ CULVERT
- TCH KILOMETRE POST WITHIN GLACIER NATIONAL PARK
- FLAGGING LOCATION
- LOCAL ROAD
- MAPPED FISH HABITAT
- STREAM CHANNELIZATION FEATURE
- TRANS-CANADA HIGHWAY (TCH)
- WATERCOURSE
- BOX CULVERT REPLACEMENT
- CULVERT REPLACEMENT/EXTENSION
- WATERBODY
- GRUBBING AND CLEARING LIMIT

0 100 200
1:5,000 METRES

REFERENCE(S)

1. HYDROLOGY AND RAILWAYS OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. LOCAL ROADS OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
3. HIGHWAY DATA OBTAINED FROM IHS ENERGY INC.
4. ORTHO IMAGERY OBTAINED FROM CLIENT. ADDITIONAL IMAGERY COPYRIGHT © 20090115 ESRI AND ITS LICENSORS. SOURCE: CNES/AIRBUS DS SPOT 5 SATELLITE IMAGERY. USED UNDER LICENSE, ALL RIGHTS RESERVED.
5. ALL OTHER DATA OBTAINED FROM CLIENT.

DATUM: NAD 83 UTM ZONE 11

CLIENT
PARKS CANADA

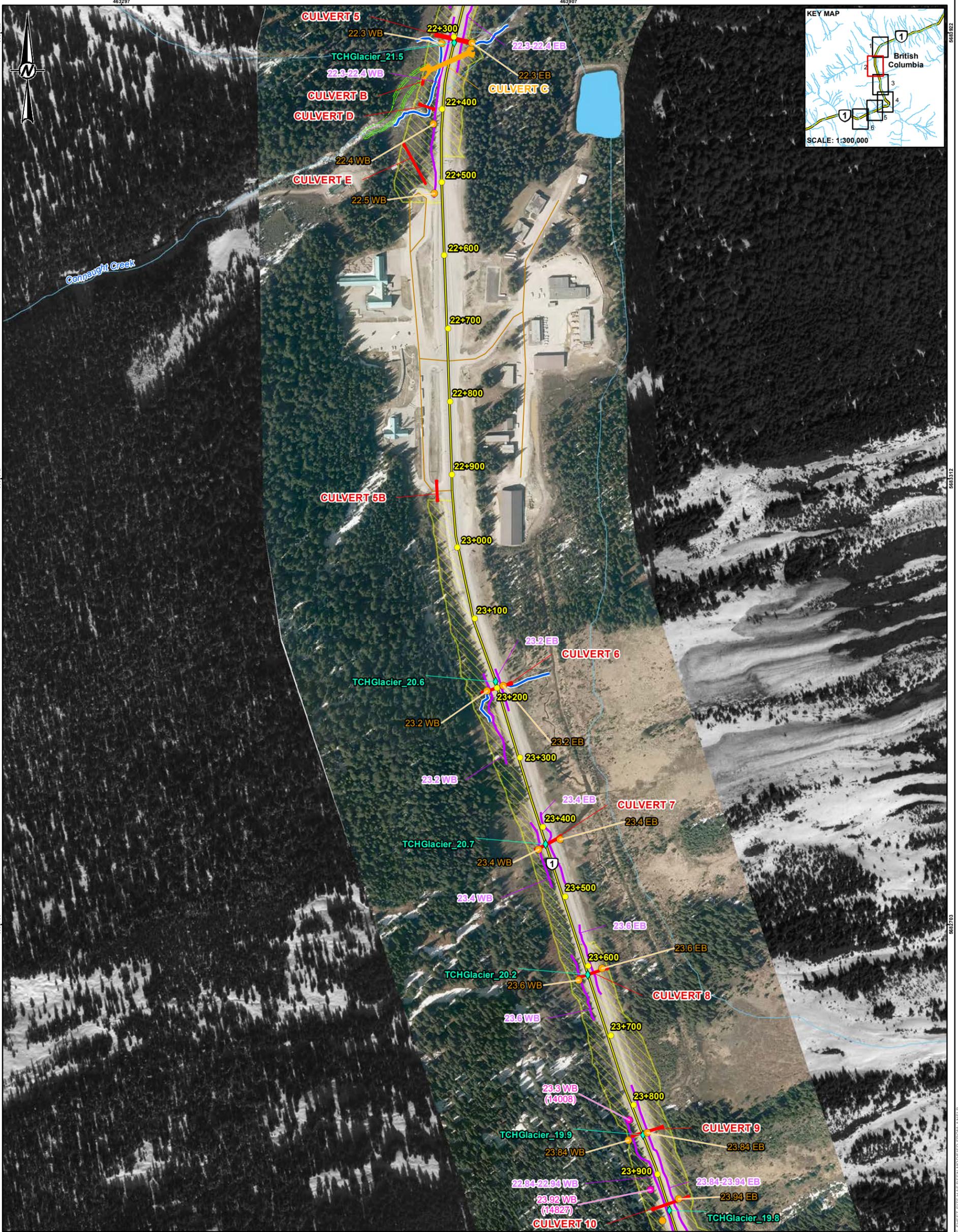
PROJECT
ILLECILLEWAET CURVE GEOTECHNICAL INVESTIGATION

TITLE
AQUATIC ASSESSMENT FIELD MAPPING

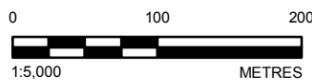
| | | |
|------------|------------|------------|
| CONSULTANT | YYYY-MM-DD | 2016-09-19 |
| | DESIGNED | AW |
| | PREPARED | RC |
| | REVIEWED | CVB |
| | APPROVED | KM |

| | | | |
|-------------|---------|------|--------|
| PROJECT NO. | CONTROL | REV. | FIGURE |
| 1654325 | | 0 | 1 |

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN ADJUSTED FROM A4 (ANSI) B



- LEGEND**
- CROSSING ASSESSMENT LOCATION
 - DITCHLINE ASSESSMENT LOCATION
 - ◆ CULVERT
 - TCH KILOMETRE POST WITHIN GLACIER NATIONAL PARK
 - FLAGGING LOCATION
 - LOCAL ROAD
 - MAPPED FISH HABITAT
 - STREAM CHANNELIZATION FEATURE
 - TRANS-CANADA HIGHWAY (TCH)
 - WATERCOURSE
 - BOX CULVERT REPLACEMENT
 - CULVERT REPLACEMENT/EXTENSION
 - WATERBODY
 - GRUBBING AND CLEARING LIMIT



REFERENCE(S)

1. HYDROLOGY AND RAILWAYS OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
 2. LOCAL ROADS OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
 3. HIGHWAY DATA OBTAINED FROM IHS ENERGY INC.
 4. ORTHO IMAGERY OBTAINED FROM CLIENT. ADDITIONAL IMAGERY COPYRIGHT © 2009/0115 ESRI AND ITS LICENSORS. SOURCE: CNES/AIRBUS DS SPOT 5 SATELLITE IMAGERY. USED UNDER LICENSE, ALL RIGHTS RESERVED.
 5. ALL OTHER DATA OBTAINED FROM CLIENT.
- DATUM: NAD 83 UTM ZONE 11

CLIENT
PARKS CANADA

PROJECT
ILLECILLEWAET CURVE GEOTECHNICAL INVESTIGATION

TITLE
AQUATIC ASSESSMENT FIELD MAPPING

CONSULTANT



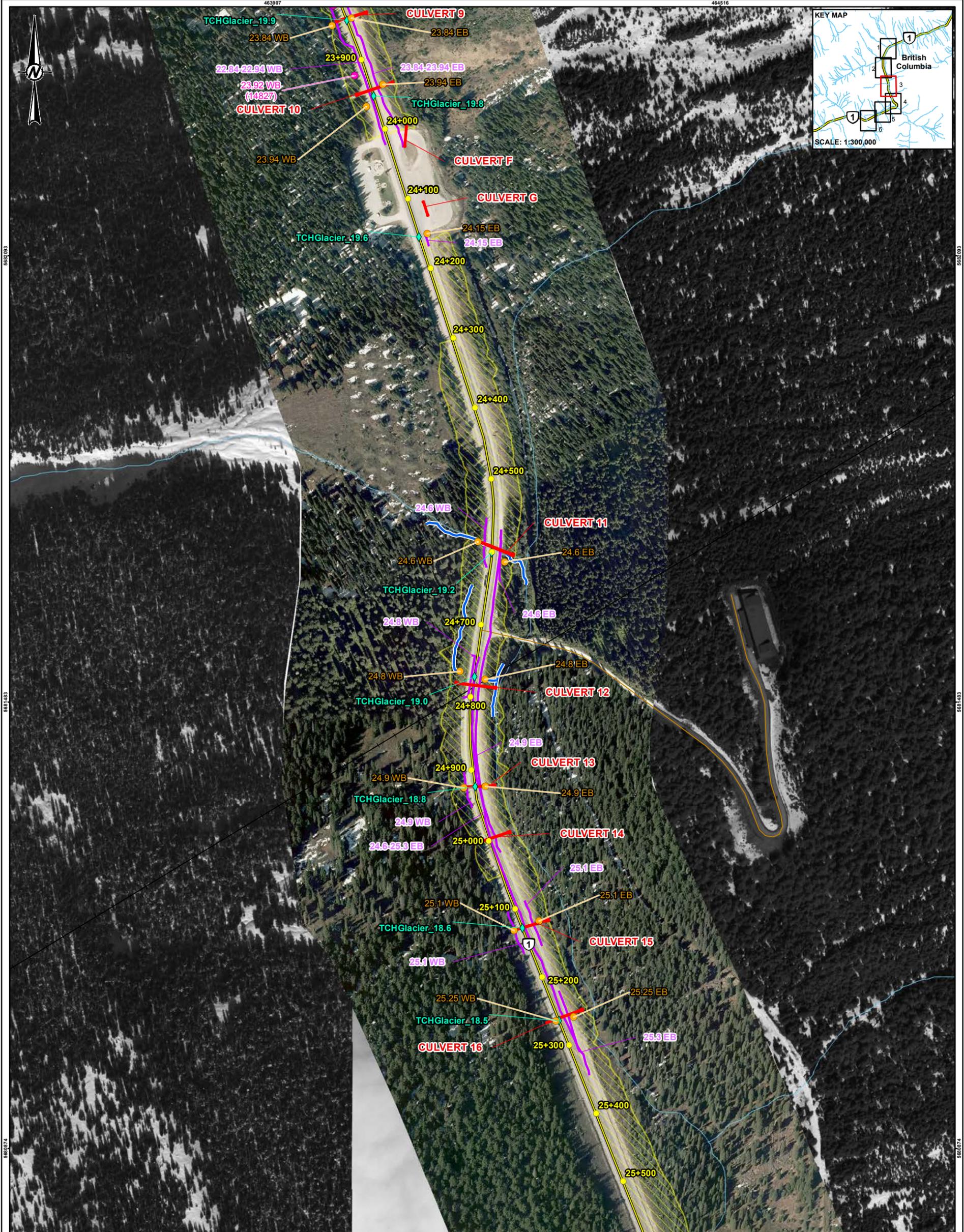
PROJECT NO.
1654325

CONTROL

REV.
0

FIGURE
2

| | |
|------------|------------|
| YYYY-MM-DD | 2016-09-19 |
| DESIGNED | AW |
| PREPARED | RC |
| REVIEWED | CVB |
| APPROVED | KM |



LEGEND

- CROSSING ASSESSMENT LOCATION
- DITCHLINE ASSESSMENT LOCATION
- ◆ CULVERT
- TCH KILOMETRE POST WITHIN GLACIER NATIONAL PARK
- FLAGGING LOCATION
- LOCAL ROAD
- MAPPED FISH HABITAT
- + RAILROAD
- TRANS-CANADA HIGHWAY (TCH)
- WATERCOURSE
- CULVERT REPLACEMENT/EXTENSION
- GRUBBING AND CLEARING LIMIT

0 100 200
1:5,000 METRES

REFERENCE(S)

1. HYDROLOGY AND RAILWAYS OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. LOCAL ROADS OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
3. HIGHWAY DATA OBTAINED FROM IHS ENERGY INC.
4. ORTHO IMAGERY OBTAINED FROM CLIENT. ADDITIONAL IMAGERY COPYRIGHT © 20090115 ESRI AND ITS LICENSORS. SOURCE: CNES/AIRBUS DS SPOT 5 SATELLITE IMAGERY. USED UNDER LICENSE, ALL RIGHTS RESERVED.
5. ALL OTHER DATA OBTAINED FROM CLIENT.

DATUM: NAD 83 UTM ZONE 11

CLIENT
PARKS CANADA

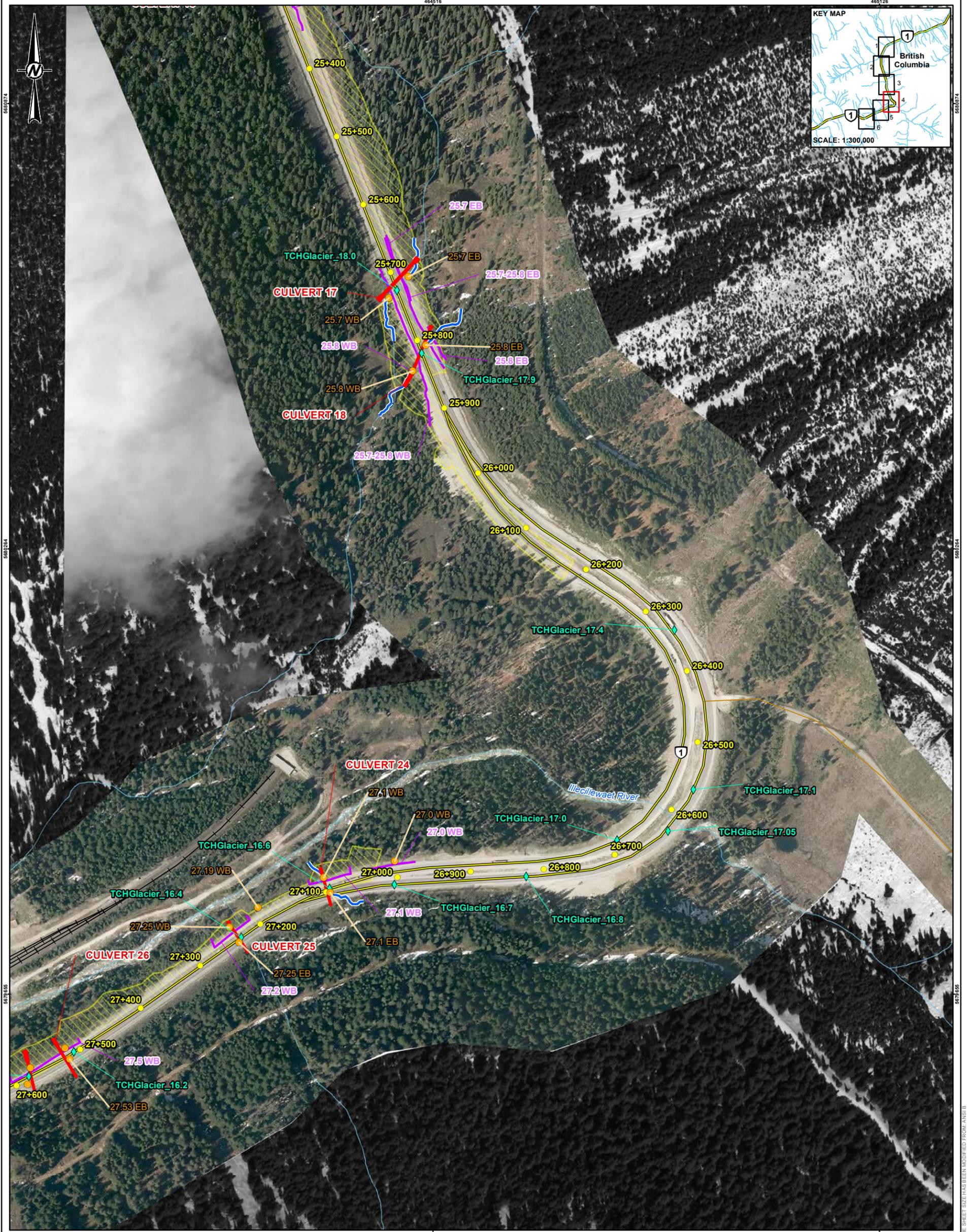
PROJECT
ILLECILLEWAET CURVE GEOTECHNICAL INVESTIGATION

TITLE
AQUATIC ASSESSMENT FIELD MAPPING

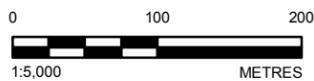
| | | |
|------------|------------|------------|
| CONSULTANT | YYYY-MM-DD | 2016-09-19 |
| | DESIGNED | AW |
| | PREPARED | RC |
| | REVIEWED | CVB |
| | APPROVED | KM |

| | | | |
|-------------|---------|------|--------|
| PROJECT NO. | CONTROL | REV. | FIGURE |
| 1654325 | | 0 | 3 |

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANS/B



- LEGEND**
- CROSSING ASSESSMENT LOCATION
 - ◆ CULVERT
 - TCH KILOMETRE POST WITHIN GLACIER NATIONAL PARK
 - FLAGGING LOCATION
 - LOCAL ROAD
 - MAPPED FISH HABITAT
 - RAILROAD
 - TRANS-CANADA HIGHWAY (TCH)
 - WATERCOURSE
 - CULVERT REPLACEMENT/EXTENSION
 - ▨ GRUBBING AND CLEARING LIMIT



REFERENCE(S)

1. HYDROLOGY AND RAILWAYS OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
 2. LOCAL ROADS OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
 3. HIGHWAY DATA OBTAINED FROM IHS ENERGY INC.
 4. ORTHO IMAGERY OBTAINED FROM CLIENT. ADDITIONAL IMAGERY COPYRIGHT © 2009/115 ESRI AND ITS LICENSORS. SOURCE: CNES/AIRBUS DS SPOT 5 SATELLITE IMAGERY. USED UNDER LICENSE, ALL RIGHTS RESERVED.
 5. ALL OTHER DATA OBTAINED FROM CLIENT.
- DATUM: NAD 83 UTM ZONE 11

CLIENT
PARKS CANADA

PROJECT
ILLECILLEWAET CURVE GEOTECHNICAL INVESTIGATION

TITLE
AQUATIC ASSESSMENT FIELD MAPPING

CONSULTANT



PROJECT NO.
1654325

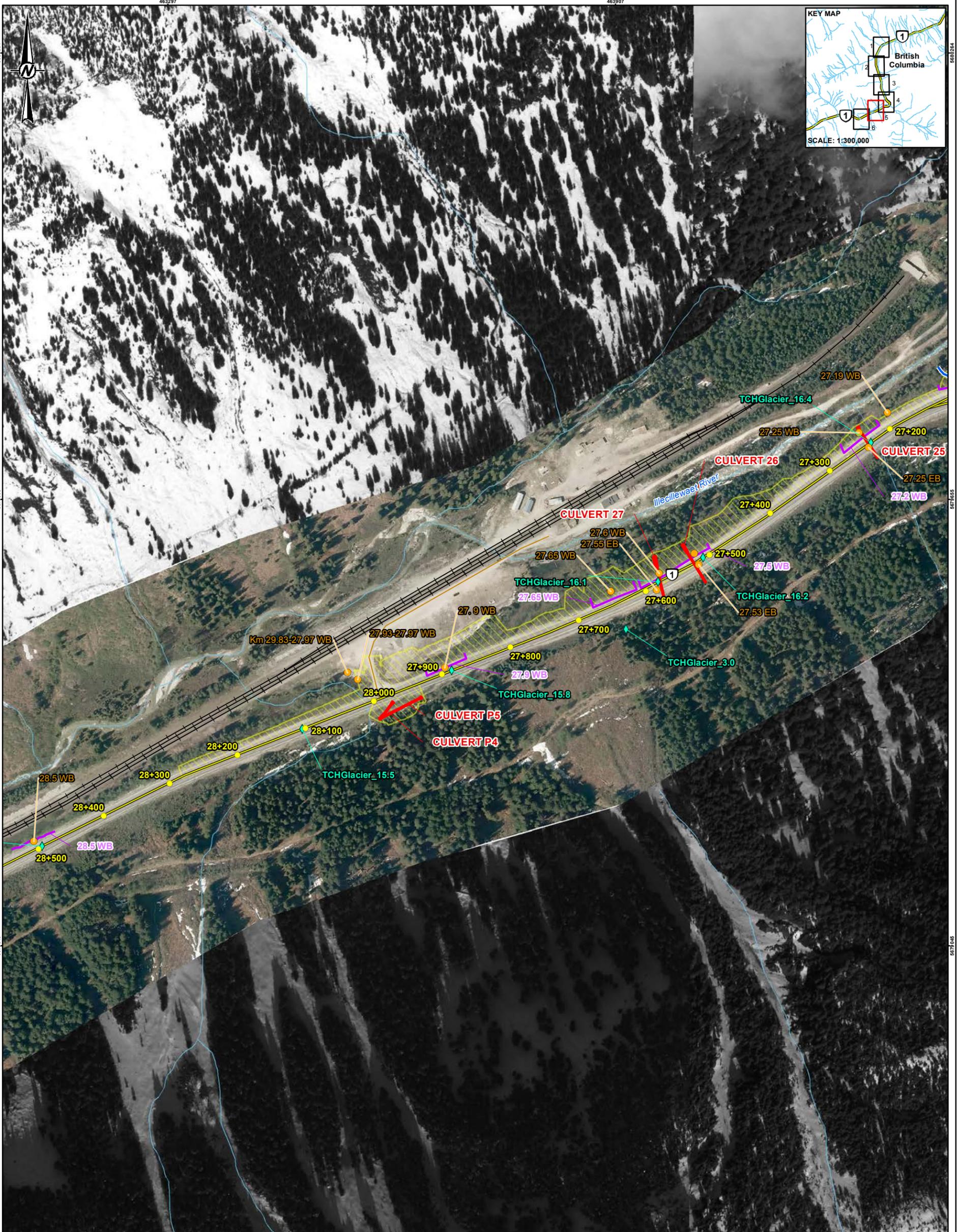
CONTROL

REV.
0

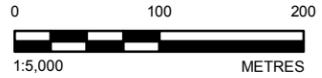
FIGURE
4

| | |
|------------|------------|
| YYYY-MM-DD | 2016-09-19 |
| DESIGNED | AW |
| PREPARED | RC |
| REVIEWED | CVB |
| APPROVED | KM |

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANS1 B



- LEGEND**
- CROSSING ASSESSMENT LOCATION
 - ◆ CULVERT
 - TCH KILOMETRE POST WITHIN GLACIER NATIONAL PARK
 - FLAGGING LOCATION
 - LOCAL ROAD
 - MAPPED FISH HABITAT
 - RAILROAD
 - TRANS-CANADA HIGHWAY (TCH)
 - WATERCOURSE
 - CULVERT REPLACEMENT/EXTENSION
 - GRUBBING AND CLEARING LIMIT



- REFERENCE(S)**
1. HYDROLOGY AND RAILWAYS OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
 2. LOCAL ROADS OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
 3. HIGHWAY DATA OBTAINED FROM IHS ENERGY INC.
 4. ORTHO IMAGERY OBTAINED FROM CLIENT. ADDITIONAL IMAGERY COPYRIGHT © 20090115 ESRI AND ITS LICENSORS. SOURCE: CNES/AIRBUS DS SPOT 5 SATELLITE IMAGERY. USED UNDER LICENSE, ALL RIGHTS RESERVED.
 5. ALL OTHER DATA OBTAINED FROM CLIENT.
- DATUM: NAD 83 UTM ZONE 11

CLIENT
PARKS CANADA

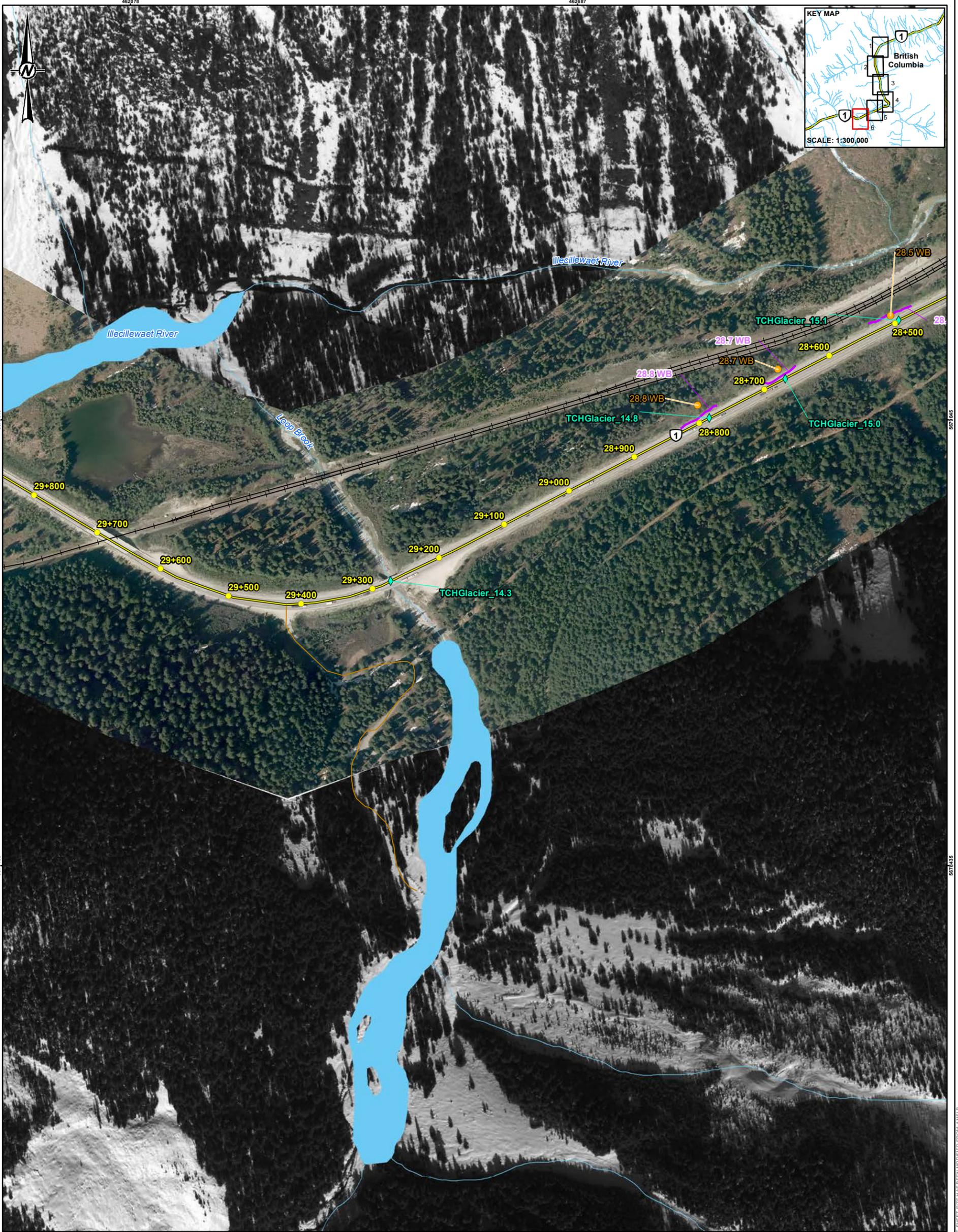
PROJECT
ILLECILLEWAET CURVE GEOTECHNICAL INVESTIGATION

TITLE
AQUATIC ASSESSMENT FIELD MAPPING

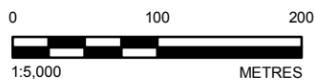
| CONSULTANT | DATE | REVISION |
|------------|------------|------------|
| | YYYY-MM-DD | 2016-09-19 |
| | DESIGNED | AW |
| | PREPARED | RC |
| | REVIEWED | CVB |
| | APPROVED | KM |

PROJECT NO. 1654325 CONTROL REV. 0 FIGURE 5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A4 (811x1194) TO A3 (841x1194)



- LEGEND**
- CROSSING ASSESSMENT LOCATION
 - ◆ CULVERT
 - TCH KILOMETRE POST WITHIN GLACIER NATIONAL PARK
 - FLAGGING LOCATION
 - LOCAL ROAD
 - +— RAILROAD
 - TRANS-CANADA HIGHWAY (TCH)
 - WATERCOURSE
 - WATERBODY



REFERENCE(S)

1. HYDROLOGY AND RAILWAYS OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
 2. LOCAL ROADS OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
 3. HIGHWAY DATA OBTAINED FROM IHS ENERGY INC.
 4. ORTHO IMAGERY OBTAINED FROM CLIENT. ADDITIONAL IMAGERY COPYRIGHT © 20090115 ESRI AND ITS LICENSORS. SOURCE: CNES/AIRBUS DS SPOT 5 SATELLITE IMAGERY. USED UNDER LICENSE, ALL RIGHTS RESERVED.
 5. ALL OTHER DATA OBTAINED FROM CLIENT.
- DATUM: NAD 83 UTM ZONE 11

CLIENT
PARCS CANADA

PROJECT
ILLECILLEWAET CURVE GEOTECHNICAL INVESTIGATION

TITLE
AQUATIC ASSESSMENT FIELD MAPPING

CONSULTANT



| | |
|------------|------------|
| YYYY-MM-DD | 2016-09-19 |
| DESIGNED | AW |
| PREPARED | RC |
| REVIEWED | CVB |
| APPROVED | KM |

PROJECT NO.
1654325

CONTROL

REV.
0

FIGURE
6



3.1 Crossings – No Watercourse/Waterbody or Fish Habitat

Between TCH km 20.6 and km 28.3 (Phase 1 and 2 of the Project), two crossing locations were identified where no watercourse or waterbody was present (i.e., no defined bed and banks), and as a result, no fish habitat being present at the TCH crossing site. TCH km 28.5 is outside of Phase 1 of the Project, but was assessed during the field surveys; the results are provided below.

3.1.1 TCH km 24.15 (TCHGlacier_19.6)

Culvert Condition: Good condition, based on the June 2016 field survey. No information for this culvert was provided in Taylor and Helms (2007).

Proposed Construction Activity: Twinning of TCH at this location, proposed East Turnaround Improvements area. However, no culvert work is planned at this location, based on the Phase 2 IFT drawing package (McElhanney 2016b). Two new culverts will be installed within the improvement area (Culverts F and G); however, these culverts will drain surface runoff from the improvement area only (McElhanney 2016b).

Fish Habitat and Connectivity Comments: Unnamed drainage that flows into an unnamed tributary of the Illecillewaet River. The drainage consisted of a ditch on the upstream, westbound side of the TCH with no defined bed or banks and no fish habitat present. A dry and undefined drainage with terrestrial vegetation was present on the downstream, eastbound side of the TCH, indicating potential flows during snowmelt periods, also with no fish habitat (Figure 7). No hydrological connectivity issues were found.

Timing of Work Window: No fish and fish habitat timing restrictions apply. If water is flowing within this drainage at the time of construction, all construction works within the flow path of this drainage will be isolated to prevent suspended sediment transport downstream to the unnamed tributary of the Illecillewaet River.



Figure 7: TCH km 24.15 (TCHGlacier_19.6) – Crossing on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)



3.1.2 TCH km 27.9 (TCHGlacier_15.8)

Culvert Condition: Culvert was identified as damaged and hanging (perched) on the downstream, westbound side of the TCH, during the June 2016 field survey. No information for this culvert was provided in Taylor and Helms (2007).

Proposed Construction Activity: Twinning of TCH at this location, with no proposed culvert replacement/extension detailed in the Phase 1 IFT drawing package (McElhanney 2016a).

Fish Habitat and Connectivity Comments: Unnamed drainage that flows into an unnamed tributary of the Illecillewaet River. The drainage consisted of a ditch on the upstream, eastbound side of the TCH with no defined bed or banks and no fish habitat present. A dry (June 2016 field survey) and undefined drainage with terrestrial vegetation was present on the downstream, eastbound side of the TCH, indicating potential flows during snowmelt periods, but no fish habitat (Figure 8). Restoring connectivity will not improve fish access due to the lack of fish-bearing habitat in the upstream and downstream sections of this drainage.

Timing of Work Window: No fish and fish habitat timing restrictions apply. If water is flowing within this drainage at the time of construction, all construction works within the flow path of this drainage will be isolated to prevent suspended sediment transport downstream to the unnamed tributary of the Illecillewaet River.



Figure 8: TCH km 27.9 (TCHGlacier_15.8) – Crossing on downstream, westbound side taken in April 2016 (left) and at the same location in June 2016 (right)



3.1.3 TCH km 28.5 (TCHGlacier_15.1)

Culvert Condition: Good condition, based on the June 2016 field survey. Taylor and Helms (2007) indicated that this culvert was not hanging (perched) and that no barriers exist.

Proposed Construction Activity: Originally part of the TCH Twinning scope, based on the Issued for 90% Review drawing package provided by McElhanney, dated February 26, 2016 (McElhanney 2016e), which included TCH km 28.3 to km 29.1; however, the scope was reduced to 28.3 in the Phase 1 IFT drawing package (McElhanney 2016a). Therefore, there is no planned twinning of the TCH at this location and no proposed culvert replacement/extension at this site.

Fish Habitat and Connectivity Comments: Unnamed drainage that flows into the Illecillewaet River. The drainage consisted of a ditch on the upstream, eastbound side of the TCH with no defined bed or banks and no fish habitat present. A dry and undefined drainage with terrestrial vegetation was present on the downstream, eastbound side of the TCH, indicating potential flows during snowmelt periods, but with no fish habitat (Figure 9). Taylor and Helms (2007) also indicated that there was no likelihood of fish at this location. No connectivity issues were found.

Timing of Work Window: Not applicable.



Figure 9: TCH km 28.5 (TCHGlacier_15.1) – Ditchline on upstream, eastbound side of TCH (left) and downstream below the culvert outlet on the westbound side (right)

3.2 Crossings – Watercourse/Waterbody with no Fish Habitat

Between TCH km 20.6 and km 28.3 (Phase 1 and 2 of the Project), there were 14 crossing locations where a watercourse or waterbody (i.e., with defined or partially-defined bed and banks) was identified, but no fish habitat was present within the watercourse/waterbody where the crossing is located (i.e., lacking adequate water depths/flows for fish or high gradient). In some cases, these watercourses/waterbodies flowed into downstream fish habitat, which was considered in the evaluation. TCH km 28.7 and 28.8 are outside of Phase 1 of the Project, but were assessed during the field surveys; the results are provided below.

Additional details for Phase 2 culverts (TCH km 20.6 to km 24.1) were provided following the field program as these became available from McElhanney (Armstrong-Bayliss 2016a,b; McElhanney 2016b).



3.2.1 TCH km 20.94 (TCHGlacier_22.8) and km 20.91

Culvert Condition: Good condition; no hanging issues identified. No information for this culvert was provided in Taylor and Helms (2007).

Proposed Construction Activity: Twinning of TCH at this location. At the access road at TCH km 20.91, a new culvert (Culvert #A1) will be installed which will be a 900 mm culvert that is 36 m in length with an additional 6.1 m³ of rip rap added for support and stabilization (Armstrong-Bayliss 2016b; McElhanney 2016b). There is a proposed culvert replacement/extension under the TCH at km 20.94 (Culvert #A2) of a 900 mm culvert, which will be 42 m in total length, with an additional 6.1 m³ of rip rap added for support and stabilization (Armstrong-Bayliss 2016b; McElhanney 2016b).

Fish Habitat and Connectivity Comments: Unnamed watercourse that flows into Connaught Creek. On the upstream, westbound side of the TCH, the watercourse consisted of multiple, poorly-defined and seasonal channels with steep slopes, cascading water, and no potential for fish to move upstream or downstream and is likely non-fish bearing. Additional dry channels were also noted in the area, indicating higher flows during snowmelt periods. Water depth in the channels was measured at less than 0.1 m. On the downstream, eastbound side of the TCH, the watercourse consists of a pool below the culvert, which flows into multiple, poorly-defined and seasonal channels with steep slopes. Water depths in these channels were less than 0.1 m, with the presence of abundant terrestrial vegetation and debris. Directly below the culvert, the watercourse is non-fish bearing (Figure 10) due to the channel gradient and cascades present towards Connaught Creek. No connectivity issues were found. Flows through this culvert are predominantly from snowmelt, as well as freshet overflow from nearby Hermit Creek (TCH km 21.06). Hermit Creek had overtopped its banks during the June 2016 field program and inundated the entire area.

Timing of Work Window: No fish have previously been documented at this location (PCA 2016b) and due to lack of fish habitat, fish presence is unlikely. No fish and fish habitat timing restrictions apply. If water is flowing within this watercourse at the time of construction, all construction works within the flow path will be isolated to prevent suspended sediment transport downstream to Connaught Creek.



Figure 10: TCH km 20.94 (TCHGlacier_22.8) – Watercourse on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)



3.2.2 TCH km 22.05 (No named culvert/stream)

Culvert Condition: Culvert was identified as hanging (perched) on the downstream, eastbound side of the TCH. No information for this culvert was provided in Taylor and Helms (2007).

Proposed Construction Activity: Twinning of TCH at this location. No proposed culvert replacement/extension detailed in the Phase 2 IFT drawing package (McElhanney 2016b).

Fish Habitat and Connectivity Comments: Unnamed watercourse that flows into Connaught Creek. On the upstream, westbound side of the TCH, the watercourse consisted of two small (less than 1 m width), shallow, seasonal channels with steep slopes and ledges with no fish habitat present that joined prior to entering through the culvert (Figure 11). On the downstream, eastbound side of the TCH, the watercourse consisted of a small, shallow, seasonal channel with steep slopes, cascading water, and no fish habitat present. Restoring connectivity will not improve fish access due to the lack of fish-bearing habitat in the upstream and downstream sections of this drainage.

Flows through this culvert are predominantly from snowmelt; however, it is possible that overland flow contributed to some of the flows in the June field survey. This was a result of the large amount of surface flow from the nearby Connaught Creek and a tributary to the north of Connaught Creek which had overtopped its banks and inundated the entire upstream, westbound area and ditchline along the TCH from km 22.0 to km 22.52.

Timing of Work Window: No fish have previously been documented at this location (PCA 2016b) and due to lack of fish habitat, fish presence is unlikely. No fish and fish habitat timing restrictions apply. If water is flowing within this watercourse at the time of construction, all construction works within the flow path will be isolated to prevent suspended sediment transport downstream to Connaught Creek.



Figure 11: TCH km 22.05 (No named culvert/stream) – Watercourse on upstream, westbound side looking upstream at the two channels (left) and looking downstream where these two channels meet and go through the culvert inlet (right)



3.2.3 TCH km 22.15 (TCHGlacier_21.6)

Culvert Condition: Culvert was identified as hanging (perched), with a very steep gradient (greater than 10%) on the downstream, eastbound side of the TCH. Taylor and Helms (2007) indicated that there was a 1.2 m drop on the culvert outlet.

Proposed Construction Activity: Twinning of TCH at this location, proposed culvert replacement/extension (Culvert #4) of an 800 mm culvert that will be extended by 3 m on the inlet side with an additional 2.3 m³ of rip rap added for support and stabilization (Armstrong-Bayliss 2016b; McElhanney 2016b).

Fish Habitat and Connectivity Comments: Unnamed watercourse that flows into Connaught Creek. On the upstream, westbound side of the TCH, the watercourse consisted of a small, shallow, seasonal channel with a steep gradient (greater than 10% gradient) with no potential for fish to move upstream or downstream and is likely non-fish bearing. Water depth in the channel was measured at less than 0.1 m. On the downstream, eastbound side of the TCH, the watercourse consisted of a small, shallow and seasonal channel with steep slopes with no fish habitat present. Water depth was measured at less than 0.1 m (Figure 12). Taylor and Helms (2007) indicated that fish presence in this watercourse was likely; however, no evidence of this was found during the June 2016 field survey. Restoring connectivity will not improve fish access due to the lack of fish-bearing habitat in the upstream and downstream sections of this drainage.

Flows through this culvert are predominantly from snowmelt; however, it is possible that overland flow contributed to some of the flows in the June field survey. This was a result of the large amount of surface flow from the nearby Connaught Creek which had overtopped its banks and inundated the entire upstream, westbound area and ditchline along the TCH from km 22.05 to km 22.52.

Timing of Work Window: No fish have previously been documented at this location (PCA 2016b) and due to lack of fish habitat, fish presence is unlikely. No fish and fish habitat timing restrictions apply. If water is flowing within this watercourse at the time of construction, all construction works within the flow path will be isolated to prevent suspended sediment transport downstream to Connaught Creek.



Figure 12: TCH km 22.15 (TCHGlacier_21.6) – Watercourse on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)



3.2.4 TCH km 23.4 (TCHGlacier_20.7)

Culvert Condition: Culvert was identified as plugged with debris and hanging (perched), with a very steep gradient (greater than 10%) on the downstream, eastbound side of the TCH. Taylor and Helms (2007) indicated that there was a 1.2 m drop on the culvert outlet.

Proposed Construction Activity: Twinning of TCH at this location, proposed culvert replacement/extension (Culvert #7), based on the Phase 2 IFT drawing package (McElhanney 2016b), which includes an extension of the inlet by 1.3 m with an additional 10.9 m³ of rip rap added for support and stabilization (Armstrong-Bayliss 2016b).

Fish Habitat and Connectivity Comments: Unnamed watercourse that flows into an unnamed creek (locally known as Rogers Creek; KWL 2016). On the upstream, westbound side of the TCH, the watercourse consisted of a small, shallow, seasonal channel with a steep gradient (greater than 10% gradient) with no fish habitat present. Water depth in the channel was measured at less than 0.1 m. On the downstream, eastbound side of the TCH, the watercourse consisted of a small, shallow, seasonal channel with steep slopes with no potential for fish to move upstream or downstream and is likely non-fish bearing. Water depth in the channel was measured at less than 0.1 m (Figure 13). Flows through this culvert are predominantly from snowmelt. Taylor and Helms (2007) indicated that fish presence in this watercourse was likely; however, no evidence of this was found during the June 2016 field survey. Restoring connectivity will not improve fish access due to the lack of fish-bearing habitat in the upstream and downstream sections of this drainage.

Timing of Work Window: No fish have previously been documented at this location (PCA 2016b) and fish presence is unlikely. No fish and fish habitat timing restrictions apply. If water is flowing within this watercourse at the time of construction, all construction works within the flow path will be isolated to prevent suspended sediment transport downstream to Rogers Creek.



Figure 13: TCH km 23.4 (TCHGlacier_20.7) – Watercourse on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)



3.2.5 TCH km 23.6 (TCHGlacier_20.2)

Culvert Condition: Culvert was identified as plugged with debris. Taylor and Helms (2007) indicated that the culvert was not hanging.

Proposed Construction Activity: Twinning of TCH at this location, proposed culvert replacement/extension (Culvert #8) based on the Phase 2 IFT drawing package (McElhanney 2016b), which includes an extension of the outlet by 4.5 m with an additional 6.1 m³ of rip rap added for support and stabilization (Armstrong-Bayliss 2016b).

Fish Habitat and Connectivity Comment: Unnamed watercourse that flows into Rogers Creek. On the upstream, westbound side of the TCH, the watercourse consisted of a small, shallow, seasonal channel with no fish habitat present. Water depth in the channel was measured at less than 0.1 m. On the downstream, eastbound side of the TCH, the watercourse consists of a small, shallow, seasonal channel with no fish habitat present. Water depth in channel was measured at less than 0.1 m (Figure 14). Flows through this culvert are predominantly from snowmelt and may be dry at other periods in the year. Taylor and Helms (2007) indicated that fish presence in this watercourse was likely; however, no evidence of this was found during the June 2016 field survey. Improving connectivity will not improve fish access due to the lack of fish-bearing habitat in the upstream and downstream sections of this drainage.

Timing of Work Window: No fish have previously been documented at this location (PCA 2016b) and fish presence is unlikely. No fish and fish habitat timing restrictions apply. If water is flowing within this watercourse at the time of construction, all construction works within the flow path will be isolated to prevent suspended sediment transport downstream to Rogers Creek.



Figure 14: TCH km 23.6 (TCHGlacier_20.2) – Watercourse on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)



3.2.6 TCH km 23.84 (TCHGlacier_19.9)

Culvert Condition: Culvert was identified as partially plugged with debris. Taylor and Helms (2007) indicated that the culvert was not hanging.

Proposed Construction Activity: Twinning of TCH at this location, proposed culvert replacement/extension (Culvert #9) based on the Phase 2 IFT drawing package (McElhanney 2016b), which includes an extension of the outlet by 9.7 m with an additional 6.1 m³ of rip rap added for support and stabilization (Armstrong-Bayliss 2016b).

Fish Habitat and Connectivity Comment: Unnamed watercourse that flows into Rogers Creek. On the upstream, westbound side of the TCH, the watercourse consisted of a small, shallow puddle in the ditchline that may originate from groundwater seepage or snowmelt with no fish habitat. Water depth in the ditch was measured at less than 0.1 m. On the downstream, eastbound side of the TCH, the watercourse consisted of a small, shallow, seasonal channel with no fish habitat. The water depth in the channel was measured at 0.15 m (Figure 15). Flows through this culvert are predominantly from snowmelt and may be dry at other periods in the year. Taylor and Helms (2007) indicated that fish presence in this watercourse was unlikely. Improving connectivity will not improve fish access due to the lack of fish-bearing habitat in the upstream and downstream sections of this drainage.

Timing of Work Window: No fish have previously been documented at this location (PCA 2016b) and fish presence is unlikely. No fish and fish habitat timing restrictions apply. If water is flowing within this watercourse at the time of construction, all construction works within the flow path will be isolated to prevent suspended sediment transport downstream to Rogers Creek.



Figure 15: TCH km 23.84 (TCHGlacier_19.9) – Poorly-defined watercourse on upstream, westbound side (left) and defined watercourse downstream below the culvert outlet on the eastbound side (right)



3.2.7 TCH km 23.94 (TCHGlacier_19.8)

Culvert Condition: Culvert was identified as plugged with debris. Taylor and Helms (2007) indicated that the culvert was not hanging.

Proposed Construction Activity: Twinning of TCH at this location, proposed culvert replacement/extension (Culvert #10), based on the Phase 2 IFT drawing package (McElhanney 2016b) which includes an extension of this culvert by 2.5 m on the upstream inlet side and 9.7 m on the downstream outlet side with an additional 6.1 m³ of rip rap added for support and stabilization (Armstrong-Bayliss 2016b).

Fish Habitat and Connectivity Comment: Unnamed watercourse that flows into unnamed tributary of Rogers Creek. On the upstream, westbound side of the TCH, the watercourse consisted of a shallow, seasonal channel that may originate from groundwater seepage or snowmelt, and does not have fish habitat. The water depth in the channel was measured at less than 0.1 m. On the downstream, eastbound side of the TCH, the watercourse consisted of a small, shallow, seasonal channel with no fish habitat. Water depth in the channel was measured at less than 0.1 m (Figure 16). Flows through this culvert are predominantly from snowmelt and may be dry at other periods in the year. Taylor and Helms (2007) indicated that fish presence in this watercourse was likely; however, no evidence of this was found during the June 2016 field survey. Improving connectivity will not provide fish access to the upstream part of this watercourse.

Timing of Work Window: No fish have previously been documented at this location (PCA 2016b) and fish presence is unlikely. No fish and fish habitat timing restrictions apply. If water is flowing within this watercourse at the time of construction, all construction works within the flow path will be isolated to prevent suspended sediment transport downstream to the unnamed tributary of Rogers Creek.



Figure 16: TCH km 23.94 (TCHGlacier_19.8) – Watercourse on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)



3.2.8 TCH km 24.9 (TCHGlacier_18.8) and km 25.0

Culvert Condition: Good condition. No information for this culvert (TCHGlacier_18.8 at km 24.9) was provided in Taylor and Helms (2007). No culvert was found at TCH km 25.0.

Proposed Construction Activity: Twinning of TCH at this location, proposed culvert replacement/extension (Culvert #13) of a 900 mm culvert that will be 13 m longer in total length than the existing culvert, and will have an additional 6.1 m³ of rip rap added for support and stabilization, based on the Phase 1 IFT drawing package (McElhanney 2016a). A new 900 mm culvert is proposed at km 25.0 (Culvert #14), which will be 6 m longer on upstream, westbound side of the TCH and 1.5 m longer on the downstream, eastbound side, and will have an additional 6.1 m³ of rip rap added for support and stabilization (McElhanney 2016a).

Fish Habitat and Connectivity Comments: Unnamed watercourse that flows into unnamed tributary of the Illecillewaet River at TCH km 24.9. On the upstream, westbound side of the TCH, the watercourse at TCH 24.9 consisted of two small, shallow, seasonal channels that may originate from groundwater seepage or snowmelt, and do not have fish habitat. Water depth in the channel was measured at less than 0.1 m. On the downstream, eastbound side of the TCH, the watercourse consisted of a small, shallow, seasonal channel with no fish habitat. Water depth in channel was less than 0.1 m (Figure 17). Flows through this culvert are predominantly from snowmelt and may be dry at other periods in the year. No connectivity issues were found.

No drainage or culvert was found at TCH km 25.0. Both ends of this culvert are buried and therefore this culvert is no longer functional (Armstrong-Bayliss 2016b). A new culvert would drain surface flows or snowmelt into the unnamed tributary of the Illecillewaet River, 100 m downstream of the drainage at km 24.9. Providing hydrological connectivity will not improve fish access due to the lack of fish-bearing habitat in the upstream and downstream sections of this watercourse.

Timing of Work Window: This watercourse flows into a known fish-bearing tributary of the Illecillewaet River; however, due to the lack of fish habitat within this watercourse, fish use is unlikely. If water is flowing within this watercourse at the time of construction, all construction works within the flow path will be isolated to prevent suspended sediment transport downstream to the unnamed tributary of the Illecillewaet River.



Figure 17: TCH km 24.9 (TCHGlacier_18.8) – Watercourse on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)



3.2.9 TCH km 25.1 (TCHGlacier_18.6)

Culvert Condition: Good condition. Taylor and Helms (2007) indicated that the culvert was not hanging.

Proposed Construction Activity: Twinning of TCH at this location, proposed culvert replacement/extension (Culvert #15) of a 900 mm culvert that will be 17 m longer on the downstream, eastbound side of the TCH, and will have an additional 3.3 m³ of rip rap added for support and stabilization, based on the Phase 1 IFT drawing package (McElhanney 2016a).

Fish Habitat and Connectivity Comment: Unnamed watercourse that flows into unnamed tributary of the Illecillewaet River. On the upstream, westbound side of the TCH, the watercourse consisted of a small, steeply graded, shallow, seasonal channel that may originate from groundwater seepage or snowmelt, and does not have fish habitat. Water depth in the channel was measured at less than 0.1 m. On the downstream, eastbound side of the TCH, the watercourse was similar to that of the upstream section; however, downstream of a shallow riffle directly below the culvert outlet, a narrow (0.5 m), 5 m long pool with 0.5 m depth was present which then flowed with a steep gradient into a tributary of the Illecillewaet River, 50 m downstream (Figure 18). Flows through this culvert are predominantly from snowmelt and may be dry at other periods in the year. Taylor and Helms (2007) indicated that fish presence in this watercourse was likely; however, no evidence of this was found during the June 2016 field survey. No connectivity issues were found.

Timing of Work Window: This watercourse flows into a known fish-bearing tributary of the Illecillewaet River; however, due to the lack of fish habitat within this watercourse, fish use is unlikely. If water is flowing within this watercourse at the time of construction, all construction works within the flow path will be isolated to prevent suspended sediment transport downstream to the unnamed tributary of the Illecillewaet River.



Figure 18: TCH km 25.1 (TCHGlacier_18.6) – Watercourse on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)



3.2.10 TCH km 25.25 (TCHGlacier_18.5)

Culvert Condition: Good condition. No information for this culvert was provided in Taylor and Helms (2007).

Proposed Construction Activity: Twinning of TCH at this location, proposed culvert replacement/extension (Culvert #16) of a 900 mm culvert that will be 13 m longer on the downstream, eastbound side of the TCH, and will have an additional 3.3 m³ of rip rap added for support and stabilization, based on the Phase 1 IFT drawing package (McElhanney 2016a).

Fish Habitat and Connectivity Comments: Unnamed watercourse that flows into unnamed tributary of the Illecillewaet River. On the upstream, westbound side of the TCH, the watercourse consisted of a ditch on the upstream, westbound side of the TCH with no fish habitat and water depth less than 0.1 m. On the downstream, eastbound side of the TCH, an incised and barely-flowing channel was present with no fish habitat; this flows downstream into a fish-bearing tributary of the Illecillewaet River (Figure 19). Flows through this culvert are predominantly from snowmelt and may be dry at other periods in the year. No connectivity issues were found.

Timing of Work Window: This watercourse flows into a fish-bearing tributary of the Illecillewaet River; however, due to the lack of fish habitat within this watercourse, fish use is unlikely. If water is flowing within this watercourse at the time of construction, all construction works within the flow path will be isolated to prevent suspended sediment transport downstream to the unnamed tributary of the Illecillewaet River.



Figure 19: TCH km 25.25 (TCHGlacier_18.5) – Watercourse on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)



3.2.11 TCH km 27.25 (TCHGlacier_16.4)

Culvert Condition: Good condition. No information for this culvert was provided in Taylor and Helms (2007).

Proposed Construction Activity: Twinning of TCH at this location, proposed culvert replacement/extension (Culvert #25) of a 900 mm culvert that will be 5.53 m longer on the downstream, westbound side of the TCH, and will have an additional 3.3 m³ of rip rap added for support and stabilization, based on the Phase 1 IFT drawing package (McElhanney 2016a).

Fish Habitat and Connectivity Comments: Unnamed watercourse that flows into the Illecillewaet River. On the upstream, eastbound side of the TCH, the watercourse consisted of a small, shallow, seasonal channel that may originate from groundwater seepage or snowmelt, with no fish habitat. Water depth was less than 0.1 m. On the downstream, westbound side of the TCH, an incised and barely flowing channel was found that flowed downstream into the Illecillewaet River (Figure 20). Flows through this culvert are predominantly from snowmelt and may be dry at other periods in the year. No connectivity issues were found.

Timing of Work Window: This watercourse flows into a known fish-bearing watercourse (Illecillewaet River); however, due to the lack of fish habitat within this watercourse, fish use is unlikely. If water is flowing within this watercourse at the time of construction, all construction works within the flow path will be isolated to prevent suspended sediment transport downstream to the Illecillewaet River.



Figure 20: TCH km 27.25 (TCHGlacier_16.4) – Watercourse on upstream, eastbound side (left) and downstream below the culvert outlet on the westbound side (right)



3.2.12 TCH km 27.5 (TCHGlacier_16.2)

Culvert Condition: Culvert was identified as damaged and hanging (perched), with a steep gradient on the downstream, westbound side of the TCH. No information for this culvert was provided in Taylor and Helms (2007).

Proposed Construction Activity: Twinning of TCH at this location, proposed culvert replacement/extension (Culvert #26) of a 800 mm culvert that will be 5.5 m longer on the downstream, westbound side of the TCH, and will have an additional 12.9 m³ of rip rap added for support and stabilization, based on the Phase 1 IFT drawing package (McElhanney 2016a).

Fish Habitat and Connectivity Comments: Unnamed watercourse that flows into the Illecillewaet River. On the upstream, eastbound side of the TCH, the watercourse consisted of small, shallow, seasonal runoff flow in the ditchline, which may originate from groundwater seepage or snowmelt, with no fish habitat. Water depth was less than less than 0.1 m. On the downstream, westbound side of the TCH, an incised, narrow channel flowed downstream into the Illecillewaet River (Figure 21). Directly below the culvert, the channel was armoured with artificially placed boulders. Flows through this culvert are predominantly from snowmelt and may be dry at other periods in the year. Restoring Improving connectivity will not improve fish access due to the lack of fish-bearing habitat in the upstream and downstream sections of this drainage.

Timing of Work Window: This watercourse flows into a known fish-bearing watercourse (Illecillewaet River); however, due to the lack of fish habitat within this watercourse, fish use is unlikely. If water is flowing within this watercourse at the time of construction, all construction works within the flow path will be isolated to prevent suspended sediment transport downstream to the Illecillewaet River.



Figure 21: TCH km 27.5 (TCHGlacier_16.2) – Watercourse on upstream, eastbound side (left) and armoured section downstream below the culvert outlet on the westbound side (right)



3.2.13 TCH km 27.6 (TCHGlacier_16.1)

Culvert Condition: Good condition, steep grade (greater than 10%) and elevated. No information for this culvert was provided in Taylor and Helms (2007).

Proposed Construction Activity: Twinning of TCH at this location, proposed culvert replacement/extension (Culvert #27) of a 1,200 mm culvert that will be 6.1 m longer on the downstream, westbound side of the TCH, and will have an additional 22.1 m³ of rip rap added for support and stabilization, based on the Phase 1 IFT drawing package (McElhanney 2016a).

Fish Habitat and Connectivity Comments: Unnamed watercourse that flows into the Illecillewaet River. On the upstream, eastbound side of the TCH, the watercourse consisted of a small (1.5 m wide), shallow, seasonal channel that has fast flowing, cascading riffles with a steep gradient (greater than 10%) with no fish habitat. Water depth was less than 0.1 m. On the downstream, westbound side of the TCH, an elevated culvert is present, with a steep channel with boulders and cascading riffles flowing downslope into the Illecillewaet River (Figure 22). Flows through this culvert are predominantly from snowmelt and may be dry at other periods in the year. No hydrological connectivity issues were found. Restoring fish passage connectivity will not improve fish access due to the lack of fish-bearing habitat in the upstream and downstream sections of this drainage.

Timing of Work Window: This watercourse flows into a known fish-bearing watercourse (Illecillewaet River); however, due to the lack of fish habitat within this watercourse, fish use is unlikely. If water is flowing within this watercourse at the time of construction, all construction works within the flow path will be isolated to prevent suspended sediment transport downstream to the Illecillewaet River.



Figure 22: TCH km 27.6 (TCHGlacier_16.1) – Watercourse on upstream, eastbound side (left) and downstream below the culvert outlet on the westbound side (right)



3.2.14 TCH km 28.0 (No named culvert/stream)

Culvert Condition: No culverts found between TCH km 27.9 and km 28.5. Taylor and Helms (2007) indicated that culvert TCHGlacier_15.5 was located at TCH km 28.1; however, field crews confirmed that no culverts were found anywhere along this section of the TCH.

Proposed Construction Activity: Twinning of TCH at this location, proposed new culvert placement (Culvert #P4 & #P5) on the eastbound side of the West Turnaround of a 900 mm and 600 mm set of culverts, which will be 60 m and 19.6 m in respective length; these culverts will be installed on the upstream, eastbound side of the TCH, and will have 5.9 m³ and 8.7 m³ of rip rap added for support and stabilization, based on the Phase 1 IFT drawing package (McElhanney 2016a).

Fish Habitat and Connectivity Comments: Unnamed watercourse that flows into the Illecillewaet River. Small (less than 1 m wide), shallow (less than 0.1 m) and seasonal overland flows were found on the downstream, westbound side of the TCH. No fish habitat was present in these small overland flow channels (Figure 23). The overland flows are a result of snowmelt and may be dry at other periods in the year. Providing hydrological connectivity will not improve fish access due to the lack of fish-bearing habitat in the upstream and downstream sections of this drainage.

Timing of Work Window: This watercourse flows into a known fish-bearing watercourse (Illecillewaet River); however, due to the lack of fish habitat within this watercourse, fish use is unlikely. If water is flowing within this watercourse at the time of construction, all construction works within the flow path will be isolated to prevent suspended sediment transport downstream to the Illecillewaet River.



Figure 23: TCH km 28.0 (No named culvert/stream) – Overland flow channels on downstream, westbound side of the TransCanada Highway looking upstream towards the highway (right) and downstream towards the Illecillewaet River (left).



3.2.15 TCH km 28.7 (TCHGlacier_15.0)

Culvert Condition: Culvert was identified as hanging (perched) on the downstream, westbound side of the TCH. This culvert was identified in Taylor and Helms (2007), but no information was provided.

Proposed Construction Activity: Originally part of the TCH Twinning scope (McElhanney 2016b), which included TCH km 28.3 to km 29.1; however the scope was reduced to km 28.3 in the Phase 1 IFT drawing package (McElhanney 2016a). Therefore, there is no planned twinning of the TCH at this location and no proposed culvert replacement/extension at this site.

Fish Habitat and Connectivity Comments: Unnamed watercourse that flows into the Illecillewaet River. The watercourse consisted of a small (less than 1 m wide), shallow, seasonal channel that has fast flowing, cascading riffles with a steep gradient and no fish habitat. Water depth was less than less than 0.1 m (Figure 24). Flows through this culvert are predominantly from snowmelt and may be dry at other periods in the year. Restoring connectivity will not improve fish access due to the lack of fish-bearing habitat in the upstream and downstream sections of this drainage.

Timing of Work Window: Not applicable.



Figure 24: TCH km 28.7 (TCHGlacier_15.0) – Hanging culvert on downstream, westbound side of TCH (left) and watercourse downstream below the culvert outlet on the westbound side (right)



3.2.16 TCH km 28.8 (TCHGlacier_14.8)

Culvert Condition: Culvert was identified as hanging (perched) on the downstream, westbound side of the TCH. This culvert was identified in Taylor and Helms (2007), but no information was provided.

Proposed Construction Activity: Originally part of the TCH Twinning scope (McElhanney 2016b), which included TCH km 28.3 to km 29.1; however, the scope was reduced to km 28.3 in the Phase 1 IFT drawing package (McElhanney 2016a). Therefore, there is no planned twinning of the TCH at this location and no proposed culvert replacement/extension at this site.

Fish Habitat and Connectivity Comment: Unnamed watercourse that flows into the Illecillewaet River. The watercourse consisted of a small (less than 1 m wide), shallow, seasonal channel that has fast flowing, cascading riffles with a steep gradient and no fish habitat. Water depth was less than less than 0.1 m (Figure 25). Flows through this culvert are predominantly from snowmelt and may be dry at other periods in the year. Restoring connectivity will not improve fish access due to the lack of fish-bearing habitat in the upstream and downstream sections of this drainage.

Timing of Work Window: Not applicable.



Figure 25: TCH km 28.8 (TCHGlacier_14.8) – Hanging culvert on downstream, westbound side of TCH (left) and watercourse downstream below the culvert outlet on the westbound side (right)



3.3 Crossings – Watercourse/Waterbody with Fish Habitat

Between TCH km 20.6 and km 28.3 (Phase 1 and 2 of the Project), 10 crossing locations where a watercourse or waterbody was identified (i.e., with defined or partially-defined bed and banks) and where fish habitat (i.e., adequate water depths/flows and suitable gradient) was present. Further mitigation measures from those stipulated in the BIA (PCA 2016a) will be required at these sites. Discharge and water quality parameters for these crossing locations are included in Appendix A.

3.3.1 TCH km 20.76 (TCHGlacier_23.0)

Culvert Condition: Culvert was identified as hanging (perched) on the downstream, westbound side of the TCH, during the site visit by the MRG Field Unit on August 17, 2016. Taylor and Helms (2007) indicated that this culvert was hanging, with a 0.5 m drop.

Proposed Construction Activity: Twinning of TCH at this location. Proposed culvert extension on the upstream westbound side of the TCH (Culvert #0) (Armstrong-Bayliss 2016a; McElhanney 2016b) which involves a 10 m extension of the 1,200 mm culvert on the inlet with rip rap added for support and stabilization (Armstrong-Bayliss 2016b). Some inlet work may be required; however, no details were available at the time of this report (McElhanney 2016b).

Fish Habitat and Connectivity Comments: The MRG Field Unit indicated that during the August 17, 2016 site visit, the watercourse was dry upstream and partially wet downstream. The culvert was noted as hanging and a barrier to fish passage. Photographs taken during the site visit indicate that this watercourse is ephemeral, with a poorly defined channel and steep slopes. Based on the imagery and the habitat assessment of similar-sized watercourses in the area, it is expected that flows through this culvert are predominantly related to spring flows, including snowmelt.

This watercourse flows into Connaught Creek, approximately 20 m downstream, a known fish-bearing stream. The likelihood of fish use was considered to be low, due to the seasonality of the flows through this watercourse; however, due to the proximity to Connaught Creek, some use of the downstream habitat may occur during high flow events (i.e., for rearing or feeding). Taylor and Helms (2007) indicated that fish presence was likely. The hanging culvert would prevent fish passage to the upstream section of the watercourse. Restoring connectivity will provide fish access to the upstream part of this watercourse.

Timing of Work Window: Fish species documented in Connaught Creek include Bull Trout (*Salvelinus confluentus*) and Mountain Whitefish (*Prosopium williamsoni*) (PCA 2016a). No fish have previously been documented at this location (PCA 2016b); however, there is a potential for fish species (including Bull Trout and Mountain Whitefish) to be present in the downstream section of this watercourse near the confluence with Connaught Creek during high flow events.

For watercourses known or expected to support fish, instream work will be conducted during periods of lowest risk to fish, if possible (PCA 2016a). The British Columbia Ministry of Environment (BCMOE) Periods of Least Risk for Instream Works for the Kootenay Region (Region 4) is June 1 to August 31 for Bull Trout, and May 1 to September 30 for Mountain Whitefish (BCMOE 2016). Therefore, instream work outside of June 1 to August 31 will only be conducted if approved by MRG Field Unit and DFO (PCA 2016a).

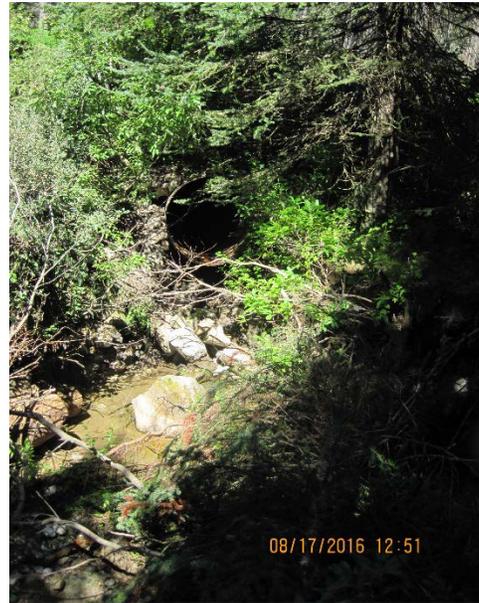


Figure 26: TCH km 21.0 (TCHGlacier_23.0) – Watercourse on upstream, westbound side of the TransCanada Highway (left) and on the downstream side, below the culvert outlet on the eastbound side of the highway (right)

3.3.2 TCH km 21.06 (Hermit Creek)

Culvert Condition: Culvert restricts flow on the upstream, westbound side of the TCH and was noted as slightly hanging (perched) on the downstream, eastbound side of the TCH. No information for this culvert was provided by Taylor and Helms (2007); however, a culvert labelled TCHGlacier_22.7 was indicated in the report, which may refer to the Hermit Creek Crossing. The report indicated that the culvert at TCHGlacier_22.7 was hanging by 0.1 m and that fish presence was likely (Taylor and Helms 2007).

Proposed Construction Activity: Twinning of TCH at this location, proposed culvert replacement/extension (Culvert #1), including a new 50 m long, 3 m wide by 2.44 m high, precast concrete box culvert, with mixed gravel, cobble and boulder substrates and additional rip rap added for support and stabilization (Stefanyk 2016; McElhanney 2016b,d).

Fish Habitat and Connectivity Comments: Named tributary (Hermit Creek) of Connaught Creek. Due to the culvert restricting flow on the upstream, westbound side of the TCH, the aquatic habitat consisted of multiple riffle channels that have found alternative flow paths and filled the ditchline along the highway. This results in overland flows to a culvert at km 21.0 (80 m east of this crossing location). Bankfull width was 15 m, with a wetted width of 7 m and maximum depth of 0.4 m. Instream cover for fish was present for all fish size classes, and substrates were predominantly cobble and boulder (Figure 27). Discharge was calculated at 1.38 m³/s. A summary of in situ water quality parameters recorded at this site is provided in Table 1.



Table 1: Summary of in situ Water Quality Parameters at TCH km 21.06 (Hermit Creek)

| Water Depth (m) | pH | Temperature (°C) | Specific Conductivity (µS/cm) | Dissolved Oxygen (mg/L) | Dissolved Oxygen (%Sat) |
|-----------------|------|------------------|-------------------------------|-------------------------|-------------------------|
| 0.3 | 6.47 | 6.46 | 12 | 10.53 | 85.4 |

Note: µS/cm: microSiemens per centimetre.

On the downstream, eastbound side of the TCH, the aquatic habitat consisted of riffle and rapid sequences below the culvert. Average bankfull width was 13.5 m, with an average wetted width of 12.3 m and a maximum depth of 0.65 m. Instream cover for fish was present for all fish size classes, and substrates were predominantly cobble and boulder. Point depth measurements ranged from 0.2 to 0.48 m, with point velocity measurements ranging from 0.6 to 1.38 m/s. Connectivity within Hermit Creek is restricted by the culvert, as fish may find it difficult to move to the upstream sections of Hermit Creek as a result of the perched nature of the culvert outlet (Figure 27). Restoring connectivity will provide fish access to the upstream part of this watercourse.

Timing of Work Window: Fish species documented in Connaught Creek include Bull Trout and Mountain Whitefish (PCA 2016a). Bull Trout have previously been documented in this tributary (PCA 2016b) and there is a high likelihood of other fish species (including Mountain Whitefish) being present.

For watercourses known or expected to support fish, instream work will be conducted during periods of lowest risk to fish, if possible (PCA 2016a). The BCMOE Periods of Least Risk for Instream Works for the Kootenay Region (Region 4) is June 1 to August 31 for Bull Trout, and May 1 to September 30 for Mountain Whitefish (BCMOE 2016). Therefore, instream work outside of June 1 to August 31 will only be conducted if approved by MRG Field Unit and DFO (PCA 2016a).



Figure 27: TCH km 21.08 (Hermit Creek) – Aquatic habitats on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)



3.3.3 TCH km 21.25 (TCHGlacier_22.5)

Culvert Condition: Culvert was identified as hanging (perched) on the downstream, eastbound side of the TCH. Taylor and Helms (2007) indicated that the culvert was hanging, with a 0.44 m drop.

Proposed Construction Activity: Twinning of TCH at this location, proposed culvert replacement/extension (Culvert #2 and #3) of two 1,200 mm culverts which will be extended by 13.8 m at both inlets with an additional 5 m³ of rip rap added to each inlet for support and stabilization (Armstrong-Bayliss 2016b; McElhanney 2016b).

Fish Habitat and Connectivity Comment: Unnamed watercourse that flows into Connaught Creek. On the upstream, westbound side of the TCH, the aquatic habitat consisted of a small, fast flowing, seasonal channel with steep slopes, and cascading water and the potential for fish presence. On the downstream, eastbound side of the TCH, the aquatic habitat consists of a small, fast flowing, seasonal channel with steep slopes and cascading water. Connectivity to Connaught Creek ends at this culvert, as fish cannot move upstream of the TCH as a result of the hanging (perched) nature of the culvert outlet (Figure 28). The watercourse is likely ephemeral, flowing primarily as a result of spring freshet; however, fish are likely to use the lower downstream section seasonally. Taylor and Helms (2007) indicated that fish presence was likely. Restoring connectivity will provide fish access to the upstream part of this watercourse.

Timing of Work Window: Fish species documented in Connaught Creek include Bull Trout and Mountain Whitefish (PCA 2016a). No fish have previously been documented at this location (PCA 2016b); however, the likelihood of fish presence in the watercourse downstream of the culvert is moderate. As a precautionary measure, it is therefore recommended that fish mitigations are followed for this watercourse.

For watercourses known or expected to support fish, instream work will be conducted during periods of lowest risk to fish, if possible (PCA 2016a). The BCMOE Periods of Least Risk for Instream Works for the Kootenay Region (Region 4) is June 1 to August 31 for Bull Trout, and May 1 to September 30 for Mountain Whitefish (BCMOE 2016). Therefore, instream work outside of June 1 to August 31 will only be conducted if approved by MRG Field Unit and DFO (PCA 2016a).



Figure 28: TCH km 21.25 (TCHGlacier_22.5) – Aquatic habitats on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)



3.3.4 TCH km 22.3 (Connaught Creek, TCHGlacier_21.5)

Culvert Condition: Culvert restricts flow on the upstream, westbound side of the TCH and was noted as hanging (perched) on the downstream, eastbound side of the TCH. No information for this culvert was provided in Taylor and Helms (2007).

Proposed Construction Activity: Twinning of TCH at this location, proposed culvert replacement/extension (Culvert #5 and #C) and new culvert installation (Culverts #B, #D and #E), based on the Phase 2 IFT drawing package (McElhanney 2016b). The final details for the Connaught Creek main channel include a new 65.2 m long, 5 m wide by 3 m high, precast concrete box culvert (Culvert #C) with mixed gravel, cobble and boulder substrates (McElhanney 2016b,c), scoped as per one of the KWL recommendations (KWL 2016), including upstream realignment and channelization (Armstrong-Bayliss 2016a). A small tributary to the north of Connaught Creek will be redirected through the existing culvert (Culvert #5) and the inlet extended by 3.4 m (McElhanney 2016b). Three new culverts (Culverts #B, #D and #E) will be installed around the proposed vehicle ponding area, whereby culverts #D and #E will drain runoff from the area into a ditch what will drain through culvert #B into the new channelized section of Connaught Creek (McElhanney 2016b).

Fish Habitat and Connectivity Comments: The main channel of Connaught Creek enters a culvert at km 22.3; however, two additional drainages (originating directly west of TCH km 22.3 and km 22.5) also converge with the main channel. During the June 2016 field survey, the overflow from these channels inundated the entire upstream forest and ditchline with fast flowing rapids and pooled habitats. Due to the culvert restricting flow on upstream, westbound side of the TCH, multiple riffle channels and overland flows were present along the highway. This resulted in overland flooding along the upstream, westbound side of the TCH from km 22.05 to km 22.52. Fish habitat was assessed and mapped, where possible. Bankfull width averaged 15 m with an average wetted width of 8 m (where it was confined to the channel) to greater than 20 m (where it was beyond the bankfull limit and flooding). The maximum depth was 0.7 m. Instream cover for fish was present for all fish size classes (favouring larger size classes at the time of survey due to the volume and velocities) and substrates were predominantly cobble and boulder (Figure 29). Flows from additional channels at TCH km 22.4 and km 22.5 (Figure 30) joined with the main channel of Connaught Creek. Discharge was not measured due to the safety risk from the fast flows. Point depth measurements in the main channel of Connaught Creek ranged from 0.2 to 0.4 m, with point velocity measurements ranging from 1.08 to 1.22 m/s. A summary of in situ water quality parameters recorded at this site is provided in Table 2.

Table 2: Summary of in situ Water Quality Parameters at TCH km 22.3 (Connaught Creek)

| Water Depth (m) | pH | Temperature (°C) | Specific Conductivity (µS/cm) | Dissolved Oxygen (mg/L) | Dissolved Oxygen (%Sat) |
|-----------------|------|------------------|-------------------------------|-------------------------|-------------------------|
| 0.2 | 7.44 | 6.84 | 28 | 13.73 | 112.7 |

Note: µS/cm: microSiemens per centimeter.

On the downstream, eastbound side of the TCH, the aquatic habitat consisted of fast flowing and turbulent rapid sequences below the culvert. Bankfull width was 15 m, with an average wetted width of 12 m and a maximum depth of 0.5 m. Instream cover for fish was present for all fish size classes (favouring larger size classes at the time of survey due to the volume and velocities) and substrates were predominantly cobble and boulder. Point depth and velocity measurements could not be measured due to the safety risk from the fast flows.



Fish passage through the culvert is compromised at low flows due to the hanging (perched) state of the culvert (Figure 31), along with high velocities at various flow conditions. Restoring connectivity will provide fish access to the upstream part of this watercourse, provided that adequate fish passage designs, as suggested by Streamworks (2014) and KWL (2016) are incorporated.

Timing of Work Window: Fish species documented in Connaught Creek include Bull Trout and Mountain Whitefish (PCA 2016a). The likelihood of other fish species being present is high. Bull Trout presence in Connaught Creek has been recently confirmed during electrofishing downstream of the highway culvert (KWL 2016). Recent electrofishing efforts, upstream of the culvert, have not confirmed fish presence (PCA 2016a).

For watercourses known or expected to support fish, instream work will be conducted during periods of lowest risk to fish, if possible (PCA 2016a). The British Columbia Ministry of Environment (BCMOE) Periods of Least Risk for Instream Works for the Kootenay Region (Region 4) is June 1 to August 31 for Bull Trout, and May 1 to September 30 for Mountain Whitefish (BCMOE 2016). Therefore, instream work outside of June 1 to August 31 will only be conducted if approved by MRG Field Unit and DFO (PCA 2016a).



Figure 29: TCH km 22.3 (Connaught Creek, TCHGlacier_21.5) – Aquatic habitats of Connaught Creek on upstream, westbound side, looking upstream above the culvert inlet (left) and downstream towards the culvert inlet (right)



Figure 30: TCH km 22.4 to 22.5 – Aquatic habitats and inundated forest of channels flowing into Connaught Creek on upstream, westbound side, looking west at TCH km 22.4 (left) and southwest towards TCH km 22.5 (right)

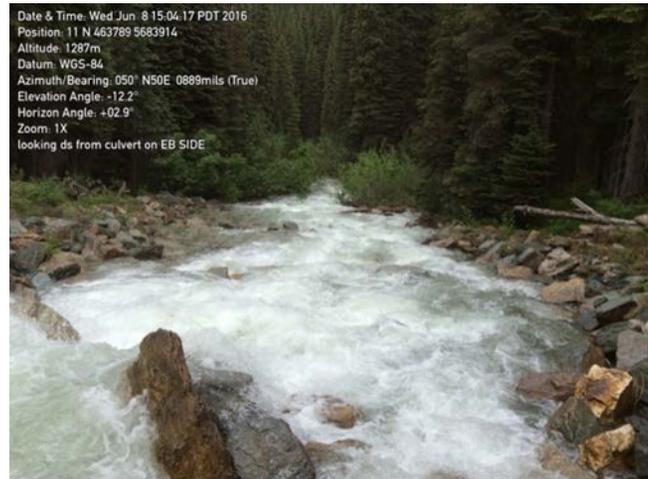


Figure 31: TCH km 22.3 (Connaught Creek, TCHGlacier_21.5) – Aquatic habitats of Connaught Creek on downstream, eastbound side, looking upstream towards the culvert outlet (left), and downstream, below the culvert outlet (right)

3.3.5 TCH km 23.2 (TCHGlacier_20.6)

Culvert Condition: Good condition; no hanging issues identified. Taylor and Helms (2007) indicated that the culvert was not hanging.

Proposed Construction Activity: Twinning of TCH at this location, proposed culvert replacement/extension (Culvert #6) based on the Phase 2 IFT drawing package (McElhanney 2016b), which includes an extension of the inlet by 4.7 m with an additional 7.6 m³ of rip rap added for support and stabilization (Armstrong-Bayliss 2016b).

Fish Habitat and Connectivity Comments: Unnamed watercourse that flows into an unnamed creek (known locally as Rogers Creek; KWL 2016). On the upstream, westbound side of the TCH, a small (less than 1 m width), shallow, seasonal ditch with terrestrial vegetation was present. The ditchline was pooled for about 100 m along the road (to TCH km 23.3) and was flowing into the downstream tributary through the culvert. Depths were less than 0.1 m with no fish habitat potential.

On the downstream, eastbound side of the TCH, the aquatic habitat below the culvert also consisted of a small, shallow, seasonal channel. Bankfull width was measured at 1.5 m, with a wetted width of 1 m and maximum depth of 0.1 m. Instream cover for fish was only present for small fish size classes, due to the shallow nature of the watercourse and minimal submergent and emergent vegetation, and substrates were predominantly sand and gravel (Figure 32). Discharge was not measured due to the small size (1.5 m width) and shallow (0.1 m) nature of the watercourse. Average point depth measurements were 0.1 m, with point velocity measurements ranging from 0.13 to 0.44 m/s. A summary of in situ water quality parameters recorded at this site is provided in Table 3. No connectivity issues were noted at the time of the survey; however, the shallow and seasonal nature of the tributary may result in periods of dry conditions at other times of the year (Figure 31). Taylor and Helms (2007) indicated that fish presence was likely. No connectivity issues were found.

Table 3: Summary of in situ Water Quality Parameters at TCH km 23.2 (TCHGlacier_20.6)

| Water Depth (m) | pH | Temperature (°C) | Specific Conductivity (µS/cm) | Dissolved Oxygen (mg/L) | Dissolved Oxygen (%Sat) |
|-----------------|------|------------------|-------------------------------|-------------------------|-------------------------|
| 0.15 | 7.27 | 5.42 | 32 | 12.1 | 95.8 |

Note: µS/cm: microSiemens per centimetre.



Timing of Work Window: Bull Trout is known to occur in Rogers Creek adjacent to the Rogers Pass Maintenance Compound and directly downstream of the confluence with this watercourse (PCA 2016a). No fish have previously been documented in this tributary (PCA 2016b) and the likelihood of large-bodied fish species presence is low, especially during low flow periods. However, based on habitat conditions, seasonal small-bodied fish species or juvenile trout presence, both upstream and downstream of the crossing, is likely.

For watercourses known or expected to support fish, instream work will be conducted during periods of lowest risk to fish, if possible (PCA 2016a). The BCMOE Periods of Least Risk for Instream Works for the Kootenay Region (Region 4) is June 1 to August 31 for Bull Trout, and May 1 to September 30 for Mountain Whitefish (BCMOE 2016). Therefore, instream work outside of June 1 to August 31 will only be conducted if approved by MRG Field Unit and DFO (PCA 2016a).



Figure 32: TCH km 23.2 (TCHGlacier_20.6) – Aquatic habitats on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)

3.3.6 TCH km 24.6 (TCHGlacier_19.2)

Culvert Condition: Culvert was identified as partially plugged (debris) on the downstream, eastbound side of the TCH. Taylor and Helms (2007) indicated that the culvert was not hanging.

Proposed Construction Activity: Twinning of TCH at this location, proposed culvert replacement/extension (Culvert #11) of a 1,200 mm culvert which will be 12 m on either side of the TCH and will have an additional 10.8 m³ of rip rap added for support and stabilization, based on the Phase 1 IFT drawing package (McElhanney 2016a).

Fish Habitat and Connectivity Comments: Unnamed watercourse that flows into an unnamed tributary of the Illecillewaet River. On the upstream, westbound and downstream, eastbound side of the TCH, the aquatic habitat consisted of a small well-defined channel with small, cascading riffle/rapid sequences and good connectivity to the downstream unnamed tributary of the Illecillewaet River. Bankfull width was measured at 5.5 m, with a wetted width of 5 m and maximum depth of 0.3 m. Instream cover for fish was only present for small and medium fish size classes and substrates were predominantly gravel and cobble (Figure 33). Discharge was calculated at 0.31 m³/s. Point depth measurements ranged from 0.1 to 0.2 m, with point velocity measurements ranging from 0.27 to 1.36 m/s. A summary of in situ water quality parameters recorded at this site is provided in Table 4. No connectivity issues were noted. Taylor and Helms (2007) indicated that fish presence was unlikely; however, based on the



habitat assessment in June 2016, fish presence, at least within the downstream section below the culvert, was considered likely. Restoring connectivity will provide fish access to the upstream part of this watercourse.

Table 4: Summary of in situ Water Quality Parameters at TCH km 24.6 (TCHGlacier_19.2)

| Water Depth (m) | pH | Temperature (°C) | Specific Conductivity (µS/cm) | Dissolved Oxygen (mg/L) | Dissolved Oxygen (%Sat) |
|-----------------|------|------------------|-------------------------------|-------------------------|-------------------------|
| 0.15 | 7.35 | 6.87 | 18 | 10.05 | 82.3 |

Note: µS/cm: microSiemens per centimetre.

Timing of Work Window: Fish species documented in the Illecillewaet River and headwaters include Bull Trout, Cutthroat Trout (*Oncorhynchus clarki*), Rainbow Trout (*Oncorhynchus mykiss*), Mountain Whitefish and Eastern Brook Trout (*Salvelinus fontinalis*); of these species, only Bull Trout has been identified as occurring near the Project in the Illecillewaet drainage (PCA 2016a). No fish have previously been documented in this tributary (PCA 2016b); however, based on habitat conditions, the likelihood of fish species presence, at least within the downstream section below the culvert, is high.

For watercourses known or expected to support fish, instream work will be conducted during periods of lowest risk to fish, if possible (PCA 2016a). The BCMOE Periods of Least Risk for Instream Works for the Kootenay Region (Region 4) is June 1 to August 31 for Bull Trout, and May 1 to September 30 for Mountain Whitefish (BCMOE 2016). Therefore, instream work outside of June 1 to August 31 will only be conducted if approved by MRG Field Unit and DFO (PCA 2016a).



Figure 33: TCH km 24.6 (TCHGlacier_19.2) – Aquatic habitats on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)



3.3.7 TCH km 24.8 (TCHGlacier_19.0)

Culvert Condition: Culvert is covered with dense vegetation and was noted as hanging (perched) on the downstream, eastbound side of the TCH. Taylor and Helms (2007) indicated that this culvert was hanging, with a 1.44 m drop.

Proposed Construction Activity: Twinning of TCH at this location, proposed culvert replacement/extension (Culvert #12) of a 900 mm culvert which will be 12 m on either side of the TCH and will have an additional 6.1 m³ of rip rap added for support and stabilization, based on the Phase 1 IFT drawing package (McElhanney 2016a).

Fish Habitat and Connectivity Comments: Unnamed watercourse that flows into an unnamed tributary of the Illecillewaet River. On the upstream, westbound side of the TCH, the aquatic habitat consisted of a shallow, well-defined channel with riffle/run sequences. Bankfull width ranged from 2.5 to 3.2 m, with a wetted width ranging from 2 to 3 m and maximum depth of 0.2 m. Instream cover for fish was only present for small and medium fish size classes and substrates were predominantly dominated by gravel and cobble (Figure 34). Discharge was not measured due to the small size (3 m width) and shallow (0.2 m) nature of the watercourse.

Average point depth measurements were 0.1 m, with point velocity measurements ranging from 0.08 to 0.38 m/s. A summary of in situ water quality parameters recorded at this site is provided in Table 5.

Table 5: Summary of in situ Water Quality Parameters at TCH km 24.8 (TCHGlacier_19.0)

| Water Depth (m) | pH | Temperature (°C) | Specific Conductivity (µS/cm) | Dissolved Oxygen (mg/L) | Dissolved Oxygen (%Sat) |
|-----------------|-----|------------------|-------------------------------|-------------------------|-------------------------|
| 0.1 | 6.8 | 4.15 | 67 | 13.42 | 102.8 |

Note; µS/cm: microSiemens per centimetre.

On the downstream, eastbound side of the TCH, the aquatic habitat conditions were similar; however, the culvert is hanging (perched) at the outlet and therefore likely to restrict fish passage at all but extreme freshet flows. Bankfull width ranged from 2 to 5 m, with a wetted width ranging from 1.5 to 3 m and maximum depth of 0.3 m. Instream cover for fish was present for small and medium fish size classes and substrates were predominantly gravel, cobble, and boulder (Figure 34). Average point depth measurements ranged from 0.1 to 0.2 m, with point velocity measurements ranging from 0.13 to 0.69 m/s. Connectivity with the downstream tributary of the Illecillewaet River is restricted, as fish may find it difficult to move upstream of the TCH as a result of the hanging (perched) nature of the culvert outlet. The watercourse is likely ephemeral, flowing primarily as a result of spring freshet. Taylor and Helms (2007) indicated that fish presence was likely. Restoring connectivity will provide fish access to the upstream part of this watercourse.

Timing of Work Window: Only Bull Trout has been identified as occurring near the Project in the Illecillewaet drainage (PCA 2016a). No fish have been documented in this tributary (PCA 2016b), and the likelihood of large-bodied fish species presence is low. However, based on habitat conditions, seasonal small-bodied fish species or juvenile trout presence is likely.

For watercourses known or expected to support fish, instream work will be conducted during periods of lowest risk to fish, if possible (PCA 2016a). The BCMOE Periods of Least Risk for Instream Works for the Kootenay Region (Region 4) is June 1 to August 31 for Bull Trout, and May 1 to September 30 for Mountain Whitefish (BCMOE 2016). Therefore, instream work outside of June 1 to August 31 will only be conducted if approved by MRG Field Unit and DFO (PCA 2016a).



Figure 34: TCH km 24.6 (TCHGlacier_19.0) – Aquatic habitats on upstream, westbound side (left) and downstream below the culvert outlet on the eastbound side (right)

3.3.8 TCH km 25.7 (TCHGlacier_18.0)

Culvert Condition: Good condition. Taylor and Helms (2007) indicated that this culvert was hanging, with a 0.25 m drop. The culvert was not hanging during the June 2016 field survey; however, flows were high during the survey and the culvert may become perched at lower flows.

Proposed Construction Activity: Twinning of TCH at this location, proposed culvert replacement/extension (Culvert #17) of a 1,800 mm culvert which will be 20 m longer in total length than the existing culvert, and will have an additional 3.3 m³ of rip rap added to the upstream, eastbound side for support and stabilization, based on the Phase 1 IFT drawing package (McElhanney 2016a).

Fish Habitat and Connectivity Comment: Unnamed watercourse that flows into the Illecillewaet River. On the upstream, eastbound side of the TCH, the aquatic habitat consisted of a well-defined channel with cascading riffles. Bankfull width was 6 m, with a wetted width 5.5 m and maximum depth of 0.6 m. Instream fish cover was present for all fish size classes, and substrates were predominantly cobble and boulder (Figure 35). Discharge was not measured due to the safety risk from the fast flows. Point depth measurements ranged from 0.2 to 0.3 m, with point velocity measurements ranging from 0.58 to 0.95 m/s. A summary of in situ water quality parameters recorded at this site is provided in Table 6. On the downstream, westbound side of the TCH, the aquatic habitat was similar. Bankfull width ranged from 3 to 4.5 m, with a wetted width ranging from 2.5 to 4.1 m and maximum depth of 0.5 m. Instream cover for fish was again present for all fish size classes and substrates were predominantly cobble and boulder (Figure 36). Discharge was calculated at 0.6 m³/s. Point depth measurements ranged from 0.2 to 0.5 m, with point velocity measurements ranging from 0.32 to 0.98 m/s. The MRG Field Unit indicated that there was a downstream wetland in the vicinity (PCA 2016c). No connectivity issues were found. Taylor and Helms (2007) indicated that fish presence was likely.

Table 6: Summary of in situ Water Quality Parameters at TCH km 25.7 (TCHGlacier_18.0)

| Water Depth (m) | pH | Temperature (°C) | Specific Conductivity (µS/cm) | Dissolved Oxygen (mg/L) | Dissolved Oxygen (%Sat) |
|-----------------|------|------------------|-------------------------------|-------------------------|-------------------------|
| 0.15 | 7.19 | 6.0 | 47 | 12.94 | 104.0 |

Note: µS/cm: microSiemens per centimetre.



Timing of Work Window: Only Bull Trout has been identified as occurring near the Project in the Illecillewaet drainage (PCA 2016a). Bull Trout have previously been documented in this creek (PCA 2016b) and the likelihood of other fish species being present is high.

For watercourses known or expected to support fish, instream work will be conducted during periods of lowest risk to fish, if possible (PCA 2016a). The BCMOE Periods of Least Risk for Instream Works for the Kootenay Region (Region 4) is June 1 to August 31 for Bull Trout, and May 1 to September 30 for Mountain Whitefish (BCMOE 2016). Therefore, instream work outside of June 1 to August 31 will only be conducted if approved by MRG Field Unit and DFO (PCA 2016a).



Figure 35: TCH km 25.7 (TCHGlacier_18.0) – Aquatic habitats of the unnamed creek on upstream, eastbound side, looking upstream above the culvert inlet (left) and downstream towards the culvert inlet (right)



Figure 36: TCH km 25.7 (TCHGlacier_18.0) – Aquatic habitats of the unnamed creek on downstream, westbound side, looking downstream, below the culvert outlet (left), and upstream towards the culvert outlet (right)



3.3.9 TCH km 25.8 (TCHGlacier_17.9)

Culvert Condition: Culvert was identified as broken and hanging (perched) on the downstream, westbound side of the TCH. No information for this culvert was provided in Taylor and Helms (2007).

Proposed Construction Activity: Twinning of TCH at this location, proposed twin-culvert replacement/extension (Culvert #18) of a 1,000 mm culvert which will be 22.7 m longer in total length than the existing culvert, and will have an additional 13.1 m³ of rip rap added to the upstream, eastbound side and 11.3 m³ of rip rap added to the downstream, westbound side for support and stabilization, based on the Phase 1 IFT drawing (McElhanney 2016a).

Fish Habitat and Connectivity Comment: Unnamed watercourse that flows into the Illecillewaet River. On the upstream, eastbound side of the TCH, the aquatic habitat consisted of a small, fast flowing, seasonal channel with steep slopes and cascading water. On the downstream, eastbound side of the TCH, the aquatic habitat consisted of a small, fast flowing, seasonal channel with steep slopes and cascading riffles. Discharge was not measured due to the small size of the stream (less than 1 m). Average point depth measurements ranged between 0.1 and 0.48 m, with point velocity measurements ranging from 0.29 to 0.85 m/s. Connectivity to the downstream Illecillewaet River is restricted, as fish may find it difficult to move upstream of the TCH as a result of the hanging (perched) nature of the culvert outlet. The watercourse is likely ephemeral, flowing primarily as a result of spring freshet; however, fish are likely to seasonally use the lower downstream section (Figure 37). A summary of in situ water quality parameters recorded at this site is provided in Table 7. The MRG Field Unit indicated that there was a downstream wetland in the vicinity (PCA 2016c). Restoring connectivity will provide fish access to the upstream part of this watercourse.

Table 7: Summary of in situ Water Quality Parameters at TCH km 25.8 (TCHGlacier_17.9)

| Water Depth (m) | pH | Temperature (°C) | Specific Conductivity (µS/cm) | Dissolved Oxygen (mg/L) | Dissolved Oxygen (%Sat) |
|-----------------|------|------------------|-------------------------------|-------------------------|-------------------------|
| 0.1 | 7.12 | 4.76 | 88 | 11.4 | 88.0 |

Note: µS/cm: microSiemens per centimetre.

Timing of Work Window: Only Bull Trout has been identified as occurring near the Project in the Illecillewaet drainage (PCA 2016a). No fish have previously been documented at this location (PCA 2016b); however, based on habitat conditions, the likelihood of seasonal fish presence in the watercourse downstream of the culvert is high.

For watercourses known or expected to support fish, instream work will be conducted during periods of lowest risk to fish, if possible (PCA 2016a). The BCMOE Periods of Least Risk for Instream Works for the Kootenay Region (Region 4) is June 1 to August 31 for Bull Trout, and May 1 to September 30 for Mountain Whitefish (BCMOE 2016). Therefore, instream work outside of June 1 to August 31 will only be conducted if approved by MRG Field Unit and DFO (PCA 2016a).



Figure 37: TCH km 25.8 (TCHGlacier_17.9) – Aquatic habitats on upstream, eastbound side (left) and downstream below the culvert outlet on the westbound side (right)

3.3.10 TCH km 27.1 (TCHGlacier_16.6)

Culvert Condition: Culvert was identified as broken and hanging (perched) on the downstream, westbound side of the TCH. No information for this culvert was provided in Taylor and Helms (2007).

Proposed Construction Activity: Twinning of TCH at this location, proposed twin-culvert replacement/extension (Culvert #24) of a 600 mm culvert which will be 5.9 m longer in total length than the existing culvert, and will have an additional 6.6 m³ of rip rap added to the downstream, westbound side for support and stabilization, based on the Phase 1 IFT drawing package (McElhanney 2016a).

Fish Habitat and Connectivity Comment: Unnamed watercourse that flows into the Illecillewaet River. On the upstream, eastbound side of the TCH, the aquatic habitat consisted of a small, fast flowing, seasonal channel with steep slopes and cascading riffles. On the downstream, westbound side of the TCH, the aquatic habitat consisted of a small, fast flowing, seasonal channel with steep slopes and cascading riffles. Discharge was not measured due to the small size of the stream (less than 1 m). Depth measurements were all measured at less than 0.1 m, with point velocity measurements ranging from 0.45 to 0.57 m/s. Connectivity to the downstream Illecillewaet River is restricted, as fish may find it difficult to move upstream of the TCH as a result of the hanging (perched) nature of the culvert outlet (Figure 38). The watercourse is likely ephemeral, flowing primarily as a result of snowmelt and rainfall on the upper slopes. A summary of in situ water quality parameters recorded at this site is provided in Table 8. Restoring connectivity will provide fish access to the upstream part of this watercourse.

Table 8: Summary of in situ Water Quality Parameters at TCH km 27.1 (TCHGlacier_16.6)

| Water Depth (m) | pH | Temperature (°C) | Specific Conductivity (µS/cm) | Dissolved Oxygen (mg/L) | Dissolved Oxygen (%Sat) |
|-----------------|------|------------------|-------------------------------|-------------------------|-------------------------|
| less than 0.1 | 7.48 | 6.73 | 215 | 10.33 | 84.6 |

Note: µS/cm: microSiemens per centimetre.

Timing of Work Window: Only Bull Trout has been identified as occurring near the Project in the Illecillewaet drainage (PCA 2016a). No fish have previously been documented at this location (PCA 2016b); however, based on habitat conditions, the likelihood of seasonal fish presence downstream of the culvert is moderate.



For watercourses known or expected to support fish, instream work will be conducted during periods of lowest risk to fish, if possible (PCA 2016a). The BCMOE Periods of Least Risk for Instream Works for the Kootenay Region (Region 4) is June 1 to August 31 for Bull Trout, and May 1 to September 30 for Mountain Whitefish (BCMOE 2016). Therefore, instream work outside of June 1 to August 31 will only be conducted if approved by MRG Field Unit and DFO (PCA 2016a).



Figure 38: TCH km 27.1 (TCHGlacier_16.6) – Aquatic habitats on upstream, eastbound side (left) and downstream below the culvert outlet on the westbound side (right).

4.0 RECOMMENDATIONS FOR MEASURES AND STANDARDS TO MITIGATE SERIOUS HARM TO FISH

4.1 General Mitigation Measures Included in the BIA

The implementation of mitigation measures and best management practices is an important aspect to incorporate into this Project to eliminate or mitigate serious harm to fish during the planned activities. Key protection measures for this Project were provided in the BIA (PCA 2016a), including the following Surface Water Quality and Fish and Fish Habitat mitigations:

- Work will be undertaken in such a manner as to prevent the release of sediment-laden water, raw concrete or concrete leachate, or any other deleterious substance into a watercourse, tributary or drainage ditch which leads to fish habitat.
- Fuels, gases, or other deleterious substances will not be stored where leaks and spills have the potential to travel down gradient and enter any watercourse.
- Effective sediment and erosion control measures will be installed before starting work near watercourses. Sediment and erosion control measures will be inspected regularly during the course of construction and repairs shall be made as necessary.
- The site will be secured against erosion during any periods of construction inactivity or shutdown.



- Work within a 30 m buffer of watercourses requires the close oversight of The MRG Field Unit or a Qualified Environmental Professional (QEP) if the MRG Field Unit staff are unavailable, as well as an HES Departmental Representative. Soils disturbed as a result of vegetation clearing within the 30 m buffer of watercourses will be stabilized in as timely a manner as possible to prevent mobilization of sediment to the watercourse.
- Machinery, equipment, and construction personnel will not enter any watercourse associated with the Project. All work will occur above the high water mark and in a manner that minimizes disturbances to the natural materials and vegetation that contribute to fish habitat or stream channel stability.
- The clearing of riparian vegetation will be minimized where practical. Riparian vegetation will be re-established as soon as possible. The MRG Fire/Vegetation specialist will be consulted regarding appropriate reclamation measures, including but not limited to rates of reseeding, live-staking and ongoing site monitoring.
- Machinery washing and fuel storage is to be at least 100 m away from any watercourse.
- Refuelling and servicing (e.g., equipment lubrication) will ideally be at least 100 m away from any watercourse. Because very little of the Project area is more than 100 m from a watercourse, locations within 100 m of a watercourse may be required and determined in consultation with the Environmental Surveillance Officer.
- In the event of any fluid spills or leaks exceeding 5 litres or any spill quantity to water, all other work shall be stopped and all personnel devoted to spill containment and cleanup.
- Direct effects of sediment on fish will be minimized by using the practices specified above.
- Work will be conducted according to BC Ministry of Environment's Guidebook for Instream Work (<http://www.env.gov.bc.ca/wld/instreamworks/index.htm>) and DFO guidance on projects near water (<http://www.dfo-mpo.gc.ca/pnwpppe/index-eng.html>).
- All instream work will be conducted in isolation of water, and where appropriate, fish will be salvaged during dewatering. Full details regarding instream works, including but not limited to identifying number of pumps, pump capacity, dam designs, screen size and monitoring will be provided in the EPP.
- All existing culverts that are in poor condition or not to current standards will be replaced to improve water connectivity and fish passage. Culvert specifications will be provided in the EPP.
- Removal, rehabilitation, and installation of culverts will be conducted in such a manner to minimize the disturbance footprint.

BMPs for roadway, highway, parkway and related infrastructure (PCA 2015) provide mitigations for construction activities related to highway widening, vegetation removal, culvert design and installation, and erosion and sediment control. These BMPs were reviewed and incorporated into the site-specific mitigations for the crossings assessed in Section 3.0. Based on the site-specific fish habitat assessments, additional site-specific mitigation measures, over and above those in the BIA, are recommended for all crossings identified in Section 3.0. These mitigation measures are provided in Sections 4.2, 4.3, and 4.4 and summarized for each crossing location in Appendix B.



4.2 Additional Site-Specific Mitigation Measures for Crossings with no Watercourse/Waterbody and no Fish Habitat

At the two crossing locations where no watercourse or waterbody was present and where no fish habitat was present at the TCH crossing site (Section 4.2), the following additional mitigation measures are recommended:

- The PCA BMPs will be followed at all sites where culverts are to be repaired, extended or replaced.
- Under the BMPs, all culverts will be specifically designed and placed so as not to impede flows. This includes repairing or replacing all existing culverts that are currently hanging (perched) or impeding flows.
- Where possible, construction works will be undertaken during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment.
- Prior to construction, the MRG Field Unit will review the site-specific culvert designs and evaluate whether they will meet the requirements under the BIA and BMPs. Any additional mitigations required will be incorporated into the EPP.
- If water is flowing at the time of construction, all construction works within the flow path of these drainages will be isolated to prevent suspended sediment transport to the downstream watercourses. In addition, flows will be diverted around the isolation work, in accordance with the specifications in the BMPs.
- During construction, the MRG Field Unit will be on-site as QEP/ESO to ensure that all mitigation measures specified in the EPP are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction.

4.3 Additional Site-Specific Mitigation Measures for Crossings with a Watercourse/Waterbody but no Fish Habitat

At the 14 crossing locations where a watercourse or waterbody was identified (i.e., defined or partially defined bed and banks), but where no fish habitat was present where the crossing is located, the following additional mitigation measures are recommended:

- The PCA BMPs will be followed at all sites where culverts are to be repaired, extended or replaced.
- Under the BMPs, all culverts will be specifically designed and placed so as not to impede flows. This includes repairing or replacing all existing culverts that are currently hanging (perched) or impeding flows. Where applicable, flows and channel stabilization will be improved through culvert design and placement.
- Prior to construction, the MRG Field Unit will review the site-specific culvert designs and evaluate whether they will meet the requirements under the BIA and BMPs. Any additional mitigations required will be incorporated into the EPP.
- Where possible, construction works will be undertaken during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment.
- If water is flowing at the time of construction, all construction works within these watercourses will be isolated to prevent suspended sediment transport to the downstream watercourses. In addition, flows will be diverted around the isolation work, in accordance with the specifications in the BMPs.



- Construction will be completed in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to downstream fish and fish habitat; these measures will be incorporated into the EPP.
- During construction, the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigation measures specified in the EPP are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction.

4.4 Additional Site-Specific Mitigation Measures for Crossings where a Watercourse/Waterbody with Fish Habitat is Present

At the 10 crossing locations where a watercourse or waterbody was identified and where fish habitat was present (Section 3.3), the following additional mitigations are recommended:

- The PCA BMPs will be followed at all sites where culverts are to be repaired, extended or replaced.
- Under the BMPs, all culverts will be specifically designed and placed so as not to impede flows. This includes repairing or replacing all existing culverts that are currently hanging (perched) or impeding flows. Where applicable, flows and channel stabilization will be improved through culvert design and placement.
- The culvert designs will consider the site-specific fish passage requirements and will be designed to enhance fish access, including improvement of the grade of the culverts that will be replaced, required for site-specific fish passage, as well as the installation of baffles or substrates within the culverts, as necessary, depending on the target fish species passage requirements at a specific watercourse.
- Placement of rip rap at culvert outlets will be designed to facilitate pool development and backwatering.
- Prior to construction, the MRG Field Unit and DFO will review the site-specific culvert designs and evaluate whether they will meet the requirements under the BIA/BMPs and the *Fisheries Act*, respectively. Any additional mitigations required will be incorporated into the EPP.
- At Connaught Creek, the additional mitigation measures specified by Streamworks (Streamworks 2014) and KWL (KWL 2016) will be reviewed by the construction contractor, and with agreement from the MRG Field Unit and DFO, be applied to the highway widening and culvert replacement and extension design and implementation, in order to meet fish passage objectives at this site. A separate BIA for the Connectivity Restoration Project will be completed by the MRG Field Unit, specific to this portion of work and may contain additional mitigation measures, which will be incorporated into the EPP.
- Where possible, construction works will be undertaken during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment.
- For watercourses known or expected to support fish, instream work will be conducted during periods of lowest risk to fish, if possible (PCA 2016a). The British Columbia Ministry of Environment (BCMOE) Periods of Least Risk for Instream Works for the Kootenay Region (Region 4) is June 1 to August 31 for Bull Trout, and May 1 to September 30 for Mountain Whitefish (BCMOE 2016). Therefore, instream work outside of June 1 to August 31 will only be conducted if approved by MRG Field Unit and DFO (PCA 2016a).
- All construction works within these watercourses will be isolated to prevent suspended sediment transport to the downstream watercourses. In addition, flows will be diverted around the isolation work, in accordance with the specifications under the BMPs.



- All water diversions within these watercourses will require a Restricted Activity Permit (RAP) and must include screened intakes consistent with DFO Freshwater Intake End-of-Pipe Fish Screen Guidelines (DFO 1995).
- In addition to the mitigations stipulated in the BIA regarding fish salvages, fish will only be salvaged by a QEP in accordance with the authorizations and permits issued for the associated site-specific work activities.
- The instream footprint (i.e., within the active channel below the ordinary high water mark) of the construction activities will be minimized to reduce disturbance to fish habitat.
- Construction will be completed in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to fish and fish habitat; these measures will be incorporated into the EPP.
- An instream suspended sediment monitoring program will be implemented to monitor and if necessary, to identify episodes of elevated turbidity and apply appropriate mitigation (e.g., temporary suspension of in-water activity), to reduce instream suspended sediment levels.
- During construction, the MRG Field Unit will be on-site as QEP/ESO to ensure that all mitigation measures specified in the EPP are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction.

5.0 DFO SELF-ASSESSMENT

5.1 The *Fisheries Act* and Serious Harm Determination

The *Fisheries Act* (Government of Canada 1985) focuses on protecting the productivity of commercial, recreational, and Aboriginal fisheries. Section 35(1) of the *Fisheries Act* (Government of Canada 1985) states that no person shall carry on any work, undertaking, or activity that results in serious harm to fish that are part of a commercial, recreational, or Aboriginal fishery, or to fish that support such a fishery. DFO defines **serious harm to fish** as the death of fish or any permanent alteration to, or destruction of, fish habitat (Government of Canada 1985). Further, DFO interprets serious harm to fish as (DFO 2013):

- the death of fish;
- a permanent alteration to fish habitat of a spatial scale, duration, or intensity that limits or diminishes the ability of fish to use such habitats as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes; and/or
- the destruction of fish habitat of a spatial scale, duration, or intensity that fish can no longer rely upon such habitats for use as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes.

5.2 Self-Assessment Process

A project does not require review by DFO if serious harm to fish can be avoided through recommended mitigation measures. The determination of no serious harm to fish is derived through a self-assessment process by a qualified environmental professional. As part of the self-assessment process, the potential project effects and Pathways of Effects (DFO 2016a) are reviewed and applicable stressors and mitigation measures are identified. After the potential project effects and Pathways of Effects are identified, Measures to Avoid Causing Harm (DFO 2016b) are reviewed to determine which measures would apply to the project. Residual effects are then identified, if



applicable, to determine if there is remaining potential for serious harm to fish that the identified mitigation measures are unable to mitigate.

Based on the review of the Project information and site-specific watercourse crossing assessments, the approach for the self-assessment process for the Project is to separate the culverts and watercourse crossings into the following groups:

- 1) No watercourse or waterbody present;
- 2) Watercourse or waterbody present, but no fish habitat present at the crossing; and
- 3) Watercourse or waterbody present with fish habitat present at the crossing.

5.2.1 No Watercourse or Waterbody Present

The initial screening for the DFO self-assessment process for the two crossing locations identified where Project activities are planned, is to determine if the Project activities and criteria require a DFO review (DFO 2016b). Based on Section 3.1, the TCH km 24.15 and km 27.9 crossings meet the criteria where a DFO review is not required as no defined bed and banks or fish or fish habitat was identified at the crossing locations and no connection to fish habitat is present. It is determined that serious harm to fish will not occur during the proposed activities at these locations.

5.2.2 Watercourse or Waterbody Present with No Fish Habitat Present at the Crossing

Table 9 includes the 14 crossings identified where Project activities are planned, where a watercourse or waterbody is present (with defined or partially defined bed and banks) but no fish habitat is present.

Table 9: List of Crossings with Watercourses or Waterbodies Present but No Fish Habitat Present

| | |
|---|---|
| TCH km 20.94 (TCHGlacier_22.8) and km 20.91 | TCH km 24.9 (TCHGlacier_18.8) and km 25.0 |
| TCH km 22.05 (No named culvert/stream) | TCH km 25.1 (TCHGlacier_18.6) |
| TCH km 22.15 (TCHGlacier_21.6) | TCH km 25.25 (TCHGlacier_18.5) |
| TCH km 23.4 (TCHGlacier_20.7) | TCH km 27.25 (TCHGlacier_16.4) |
| TCH km 23.6 (TCHGlacier_20.2) | TCH km 27.5 (TCHGlacier_16.2) |
| TCH km 23.84 (TCHGlacier_19.9) | TCH km 27.6 (TCHGlacier_16.1) |
| TCH km 23.94 (TCHGlacier_19.8) | TCH km 28.0 (No named culvert/stream) |

The initial screening for the DFO self-assessment process for the 14 crossing locations identified in Table 9 is to determine if the Project activities and criteria require a DFO review (DFO 2016b). The crossings identified in Table 9 do not meet the criteria where a DFO review is not required, as the proposed culvert replacement/extension will increase the footprint of the culvert below the high water mark. The results of the proposed work at the identified locations has the potential for serious harm to downstream fish and fish habitat due to potential downstream sedimentation during construction activities.

The next step of the self-assessment process requires the potential effects and Pathways of Effects (DFO 2016a) to be reviewed and applicable stressors and mitigation measures identified (Table 10). Next, DFO's Measures to Avoid Causing Harm (DFO 2016b) are reviewed to determine which measures would apply to the activities at the identified crossings. Residual effects are then identified to determine if there is remaining potential for serious harm to fish that the identified mitigation measures are unable to mitigate.



The proposed culvert replacements and extensions at the identified sites have potential to harm fish habitat due to the potential for downstream impacts to fish and fish habitat during construction; however, due to the lack of fish habitat at the site and the implementation of the mitigations identified, impacts can be mitigated such that serious harm can be avoided. The proposed construction will not impact downstream flow and the erosion control measures implemented will mitigate downstream impacts to fish and fish habitat. Any disturbance outside of the construction footprint will be returned to pre-construction conditions such that permanent alteration of downstream fish habitat will not occur. Erosion and sediment control measures will be implemented as required to prevent sediment from entering downstream fish habitat.

Based on the results of the self-assessment and in consideration of the implementation of the proposed mitigations, serious harm to fish can be avoided and a DFO Request for Review is not required for the crossings listed in Table 9.



TRANSCANADA HIGHWAY IMPROVEMENT PROJECT, GLACIER NATIONAL PARK

Table 10: Summary of Self-Assessment Process for Crossing Locations with a Defined Watercourse or Waterbody but No Fish Habitat Present

| Pathway of Effects | Stressor (Potential Impact) | Mitigation Measures | Residual Effects | Serious Harm Potential Present? |
|--|---|--|------------------|---------------------------------|
| Use of Industrial Equipment | Potential mortality of fish/eggs/ova from equipment | No fish habitat is identified at the crossings. | None | No |
| | Change in sediment concentrations | Erosion and sediment controls will be implemented that minimize risk of sedimentation to the waterbody during all phases of the construction. Effective erosion and sediment control measures will be installed where required before starting work to prevent sediment from entering any waterbody. Regular inspection, maintenance and repair of erosion and sediment control measures and structures will be completed. An environmental monitor will be on site to document potential effects beyond the zone of influence if and when in-water work occurs. Timing of work will avoid wet and rainy periods that may increase erosion and sedimentation downstream of the crossing during construction. | None | No |
| | Change in contaminant concentrations | Spill kits will be kept onboard equipment at all times for implementation in event of a spill. Equipment will be in clean condition and maintained free of fluid leaks, invasive species or noxious weeds. Stream bank and bed protection measures will be used. Equipment will be washed, refuelled and serviced away from any waterbodies. Containment and spill protection will be required for refuelling within 100 m of any waterbody. | None | No |
| Vegetation Clearing | Change in habitat structure and cover | No fish or fish habitat identified at the crossing. Clearing of vegetation will be minimized to the footprint areas with proper clearing techniques utilized, as stipulated in the BMPs (30 m aquatic buffers will be implemented where only hand clearing can be done within the 30 m buffer). Riparian vegetation will be re-planted to pre-construction or better condition. | None | No |
| | Change in sediment concentrations | Erosion and sediment controls will be implemented that minimize risk of sedimentation to the waterbody during all phases of the construction. Effective erosion and sediment control measures will be installed where required before starting work to prevent sediment from entering any waterbody. Regular inspection, maintenance and repair of erosion and sediment control measures and structures will be completed. An environmental monitor will be on site to document potential effects beyond the zone of influence if and when in-water work occurs. Timing of work will avoid wet and rainy periods that may increase erosion and sedimentation downstream of the crossing during construction. | None | No |
| | Change in food supply | Clearing of riparian vegetation will be kept to a minimum and proper clearing techniques utilized. Riparian vegetation will be re-planted to pre-construction or better condition. | None | No |
| Change in timing, duration and frequency of flow | Displacement or stranding of fish | No fish or fish habitat identified at the crossing and downstream flow will not be affected. | None | No |
| | Change in migration / access to habitats | No fish or fish habitat identified at the crossing and downstream flow will not be affected. | None | No |
| | Change in sediment concentrations | Erosion and sediment controls will be implemented that minimize risk of sedimentation to the waterbody during all phases of the construction. Effective erosion and sediment control measures will be installed where required before starting work to prevent sediment from entering any waterbody. Regular inspection, maintenance and repair of erosion and sediment control measures and structures will be completed. An environmental monitor will be on site to document potential effects beyond the zone of influence if and when in-water work occurs. Timing of work will avoid wet and rainy periods that may increase erosion and sedimentation downstream of the crossing during construction. | None | No |
| | Change in habitat structure and cover | No fish or fish habitat identified at the crossing and downstream flow will not be affected. | None | No |
| | Change in food supply | No fish or fish habitat identified at the crossing and downstream flow will not be affected. | None | No |
| Placement of material or structures in water | Change in food supply | No fish or fish habitat identified at the crossing. The effects on the food supply to downstream fish habitat is expected to be temporary or minimal. | None | No |
| | Changes in habitat structure and cover | No fish or fish habitat identified at the site. The effects on the fish habitat downstream will be negligible. | None | No |
| | Change in sediment concentrations | Erosion and sediment controls will be implemented that minimize risk of sedimentation to the waterbody during all phases of the construction. Effective erosion and sediment control measures will be installed where required before starting work to prevent sediment from entering any waterbody. Regular inspection, maintenance and repair of erosion and sediment control measures and structures will be completed. An environmental monitor will be on site to document potential effects beyond the zone of influence if and when in-water work occurs. Timing of work will avoid wet and rainy periods that may increase erosion and sedimentation downstream of the crossing during construction. | None | No |
| | Change in nutrient concentrations | No fish or fish habitat identified at the site. The effects on the nutrient concentrations to downstream fish habitat is expected to be temporary or minimal. | None | No |



5.2.3 Watercourse or Waterbody Present with Fish Habitat Present at the Crossing

Table 11 includes the 10 crossings identified where Project activities are planned, and have a watercourse or waterbody present (with defined bed and banks) and fish habitat present.

Table 11: Listing of Crossings with Watercourses or Waterbodies Present but No Fish Habitat Present

| | |
|--|-------------------------------|
| TCH km 20.76 (TCHGlacier_23.0) | TCH km 24.6 (TCHGlacier_19.2) |
| TCH km 21.06 (Hermit Creek) | TCH km 24.8 (TCHGlacier_19.0) |
| TCH km 21.25 (TCHGlacier_22.5) | TCH km 25.7 (TCHGlacier_18.0) |
| TCH km 22.3 (Connaught Creek, TCHGlacier_21.5) | TCH km 25.8 (TCHGlacier_17.9) |
| TCH km 23.2 (TCHGlacier_20.6) | TCH km 27.1 (TCHGlacier_16.6) |

The initial screening for the DFO self-assessment process for the 10 crossing locations identified is to determine if the Project activities and criteria require a DFO review (DFO 2016c). The crossings identified in Table 11 do not meet the criteria where a DFO review is not required, as the replacement and expansion of the culverts at these crossings will increase the existing footprint below the High Water Mark; therefore, the Project has the potential for serious harm to fish and fish habitat.

The next step of the self-assessment process requires the potential effects and Pathways of Effects (DFO 2016c) to be reviewed and applicable stressors and mitigation measures identified (Table 12). Next, DFO's Measures to Avoid Causing Harm (DFO 2016a) are reviewed to determine which measures would apply to the activities at the identified crossings. Residual effects are then identified to determine if there is remaining potential for serious harm to fish that the identified mitigation measures are unable to mitigate.

The proposed replacement and expansion of the ten crossings identified in Table 11 have potential to harm fish habitat due to the extension of the culvert within the fish habitat identified at the site. The culvert footprint will be increased at each of the locations due to the twinning of the TCH. The proposed construction will not impact downstream flow and the erosion control measures implemented will mitigate downstream impacts to fish and fish habitat. Any disturbance outside of the construction footprint will be returned to pre-construction conditions such that permanent alteration of downstream fish habitat will not occur. Erosion and sediment control measures will be implemented as required to prevent sediment from entering downstream fish habitat.

Based on the results of the self-assessment and in consideration of the implementation of the proposed mitigations, the potential for serious harm to fish cannot be avoided and a DFO Request for Review is required for the ten crossings listed in Table 11.



TRANSCANADA HIGHWAY IMPROVEMENT PROJECT, GLACIER NATIONAL PARK

Table 12: Summary of Self-Assessment Process for Crossing Locations with a Defined Watercourse or Waterbody and Fish Habitat Present

| Pathway of Effects | Stressor (Potential Impact) | Mitigation Measures | Residual Effects | Serious Harm Potential Present? |
|--|---|--|---|---------------------------------|
| Use of Industrial Equipment | Potential mortality of fish/eggs/ova from equipment | Work will be completed with consideration of the timing windows for each of the crossings. A fish salvage will be completed to remove fish from the isolated area and reduce potential mortalities during instream works. | None | No |
| | Change in sediment concentrations | Erosion and sediment controls will be implemented that minimize risk of sedimentation to the waterbody during all phases of the construction. Effective erosion and sediment control measures will be installed where required before starting work to prevent sediment from entering any waterbody. Regular inspection, maintenance and repair of erosion and sediment control measures and structures will be completed. An environmental monitor will be on site to document potential effects beyond the zone of influence if and when in-water work occurs. Timing of work will avoid wet and rainy periods that may increase erosion and sedimentation downstream of the crossing during construction. | None | No |
| | Change in contaminant concentrations | Spill kits will be kept onboard equipment at all times for implementation in event of a spill. Equipment will be in clean condition and maintained free of fluid leaks, invasive species or noxious weeds. Stream bank and bed protection measures will be used. Equipment will be washed, refuelled and serviced away from any waterbodies. Containment and spill protection will be required for refuelling within 100 m of any waterbody. | None | No |
| Vegetation Clearing | Change in habitat structure and cover | Clearing of vegetation will be minimized to the footprint areas with proper clearing techniques utilized, as stipulated in the BMPs (30 m aquatic buffers will be implemented where only hand clearing can be done within the 30 m buffer). Riparian vegetation will be re-planted to pre-construction or better condition. | None | No |
| | Change in sediment concentrations | Erosion and sediment controls will be implemented that minimize risk of sedimentation to the waterbody during all phases of the construction. Effective erosion and sediment control measures will be installed where required before starting work to prevent sediment from entering any waterbody. Regular inspection, maintenance and repair of erosion and sediment control measures and structures will be completed. An environmental monitor will be on site to document potential effects beyond the zone of influence if and when in-water work occurs. Timing of work will avoid wet and rainy periods that may increase erosion and sedimentation downstream of the crossing during construction. | None | No |
| | Change in food supply | Clearing of riparian vegetation will be kept to a minimum and proper clearing techniques utilized. Riparian vegetation will be re-planted to pre-construction or better condition. | None | No |
| Change in timing, duration and frequency of flow | Displacement or stranding of fish | Flow will be maintained throughout the construction at each of the crossing locations and fish will be removed from the isolated area prior to instream works. | None | No |
| | Change in migration / access to habitats | At each crossing, the culvert will be extended and fish access will be improved to upstream habitats, as the culvert will be designed to enhance fish access at each crossing location. | None | No |
| | Change in sediment concentrations | Erosion and sediment controls will be implemented that minimize risk of sedimentation to the waterbody during all phases of the construction. Effective erosion and sediment control measures will be installed where required before starting work to prevent sediment from entering any waterbody. Regular inspection, maintenance and repair of erosion and sediment control measures and structures will be completed. An environmental monitor will be on site to document potential effects beyond the zone of influence if and when in-water work occurs. Timing of work will avoid wet and rainy periods that may increase erosion and sedimentation downstream of the crossing during construction. | None | No |
| | Change in habitat structure and cover | Habitat structure and cover at each crossing location will be changed due to the extension of the culverts within existing fish habitat and below the high water mark. | Change in habitat structure and cover due to the culvert extensions | Yes |
| | Change in food supply | Culverts will be extended, but changes to food supply at each crossing are expected to be temporary. | None | No |
| Placement of material or structures in water | Change in food supply | Any effect on food supply at each crossing due to the placement of the culvert in the water is expected to be temporary. | None | No |
| | Changes in habitat structure and cover | Existing fish habitat will be lost due to the extension of the culvert footprint at each crossing, but this would not be expected to change the productivity of the fishery. | Existing fish habitat will be lost due to the extension of the culverts | Yes |
| | Change in sediment concentrations | Erosion and sediment controls will be implemented that minimize risk of sedimentation to the waterbody during all phases of the construction. Effective erosion and sediment control measures will be installed where required before starting work to prevent sediment from entering any waterbody. Regular inspection, maintenance and repair of erosion and sediment control measures and structures will be completed. An environmental monitor will be on site to document potential effects beyond the zone of influence if and when in-water work occurs. Timing of work will avoid wet and rainy periods that may increase erosion and sedimentation downstream of the crossing during construction. | None | No |
| | Change in nutrient concentrations | Any effect on nutrient concentrations due to placement of the culvert extension in the watercourses is expected to be temporary. | None | No |



6.0 CONCLUSION

The results of the self-assessments indicate that the potential for serious harm to fish cannot be avoided and a DFO Request for Review is required for the ten crossings where the watercourse has defined bed and banks and fish habitat. All the remaining crossings do not require review by DFO due to the lack of fish habitat at the site or the mitigation measures proposed will avoid serious harm to fish.

Mitigation measures and best management practices provided here, in the PCA BMPs and in the BIA will be incorporated into the EPP, to eliminate or mitigate potential effects to the fish and fish habitat as a result of the proposed works. Additional mitigations, which arise from the DFO Request for Review, or specific to the detailed designs for the culvert replacements or extensions, will also be incorporated into the EPP, prior to construction.

7.0 CLOSING

We trust that the information provided in this report meet the requirements of McElhanney and Parks Canada. Please feel free to contact the specialists listed below for any further information.

GOLDER ASSOCIATES LTD.

Cameron von Bratt, M.Sc.
Aquatic Ecologist

Kristine Mason, M.Sc., P.Biol.
Principal, Senior Fisheries Biologist

Michael Day, B.Sc.
Fisheries Biologist

CVB/KM/MD/sb/kpl/jlb

Golder, Golder Associates and the GA globe design are trademarks of Golder Associates Corporation.

\\golder.gds\calgary\active\2016\3 proj\1654325 pca glacier np cu11 i curve\05_reporting\dfo_self assessment\final_report\1654325_rp0002_aquatic_assessment.docx



8.0 REFERENCES

- Armstrong-Bayliss, S. 2016a. pers. comm. Email correspondence from Simon Armstrong-Bayliss, Project Engineer. McElhanney Consulting Services Ltd. Dated July 27, 2016.
- Armstrong-Bayliss, S. 2016b. pers. comm. Email correspondence from Simon Armstrong-Bayliss, Project Engineer. McElhanney Consulting Services Ltd. Dated August 2, 2016.
- BCMOE (British Columbia Ministry of Environment). 2016. Regional Timing Windows. Kootenay Region (Region 4) Periods of Least Risk for Instream Works by Fish Species. Available at: http://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/working-around-water/work_window_kootenays.pdf. Accessed July 29, 2016.
- DFO (Fisheries and Oceans Canada). 1995. Freshwater Intake End-of-Pipe Fish Screen Guideline. Department of Fisheries and Oceans. Ottawa, ON. ISBN 0-662-23168-6.
- DFO. 2013. *Fisheries Protection Policy Statement*. Available at: <http://www.dfo-mpo.gc.ca/pnw-ppe/pol/index-eng.html#ch82>
- DFO. 2016a. Pathways of Effects. <http://www.dfo-mpo.gc.ca/pnw-ppe/pathways-sequences/index-eng.html>. Accessed May 26 2016.
- DFO. 2016b. Measures to Avoid Causing Harm to Fish and Fish Habitat. Available at: <http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/measures-mesures-eng.html>. Accessed May 26 2016.
- DFO. 2016c. Projects Near Water. Available at: <http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html>. Accessed May 26, 2016.
- Government of Canada. 1985. *Fisheries Act* [RSC 1985], c.F-14: <http://laws-lois.justice.gc.ca/eng/acts/F-14/page-1.html>. Accessed October 2015.
- KWL (Kerr Wood Leidal Consulting Engineers). 2016. Aquatic Connectivity Restoration. Laretta and Connaught Creek. Prepared for: Parks Canada. Report April 2016.
- McElhanney (McElhanney Consulting Services). 2016a. Illecillewaet Curve Safety Improvements TCH km 20.6 to km 29.1. Phase 1 – km 24.1 to km 28.3. Rogers Pass, Glacier National Park, BC. Issued for Tender Drawings. May 1, 2016.
- McElhanney. 2016b. Illecillewaet Curve Safety Improvements TCH km 20.6 to km 29.1. Phase 2 – km 20.6 to km 24.1. Rogers Pass, Glacier National Park, BC. Issued for Tender Drawings. August 12, 2016.
- McElhanney. 2016c. Illecillewaet Curve Safety Improvements TCH km 20.6 to km 29.1. General Arrangement Precast Concrete Box Culvert at STA 21+061. Rogers Pass, Glacier National Park, BC. Drawing Reference 752. July 197, 2016.
- McElhanney. 2016d. Illecillewaet Curve Safety Improvements TCH km 20.6 to km 29.1. General Arrangement Precast Concrete Box Culvert at STA 22+325. Rogers Pass, Glacier National Park, BC. Drawing Reference 752. July 27, 2016.



- McElhanney. 2016e. Illecillewaet Curve Safety Improvements TCH km 20.6 to km 29.1. Rogers Pass, Glacier National Park, BC. Issued for 90% Review Drawings. February 26, 2016.
- PCA (Parks Canada Agency). 2015. Parks Canada National Best Management Practices. Roadway, Highway, Parkway and Related Infrastructure. Parks Canada. May 2015.
- PCA. 2016a. Basic Impact Analysis (BIA). Illecillewaet Curve Safety Improvements. Glacier National Park, BC. Parks Canada. March 2016.
- PCA. 2016b. Known fish locations along the TCH for Glacier National Park. Google Earth File (.kmz) provided by Parks Canada. April 2016.
- PCA. 2016c. Internal review comments of the Draft Fish Habitat Assessment, DFO Self-Assessment and Detailed Mitigations Summary Report. August 2016.
- Stefanyk, M. 2016. pers. comm. Email correspondence from Michael Stefanyk, Environmental Assessment Scientist, Highway Engineering Services. Parks Canada. Dated July 29, 2016.
- Streamworks Consulting Inc. (Streamworks). 2014. Connaught Creek Culvert Remediation - Fish Passage Improvements. As-Constructed Summary. Prepared for: Parks Canada Agency. Contract# 5P435-14-1014. October 2014.
- Taylor, M and S. Helms. 2007. Mountain Parks Road-Stream Crossing Assessment Report. October 2007.



APPENDIX A

Discharge and Water Quality Parameters for Watercourses with Fish Habitat



TRANSCANADA HIGHWAY IMPROVEMENT PROJECT, GLACIER NATIONAL PARK

Appendix A: Discharge and Water Quality Parameters Measured during the June 2016 Field Survey for Watercourses with Fish Habitat

| Site | Water Depth (m) | Sample Depth (m) | Temperature (°C) | DO (mg/L) | DO (%) | pH | Specific Conductivity (µS/cm) | Conductivity (µS/cm) | Discharge (m ³ /s) |
|-------------------------------|-----------------|------------------|------------------|-----------|--------|------|-------------------------------|----------------------|-------------------------------|
| TCH km 21.06 (Hermit Creek) | 0.30 | 0.25 | 6.46 | 10.53 | 85.4 | 6.47 | 12 | 8 | 1.38 |
| TCH km 22.3 (Connaught Creek) | 0.20 | 0.20 | 6.84 | 13.73 | 112.7 | 7.44 | 28 | - | - |
| TCH km 23.2 (TCHGlacier_20.6) | 0.15 | 0.15 | 5.42 | 12.1 | 95.8 | 7.27 | 32 | 18 | - |
| TCH km 24.6 (TCHGlacier_19.2) | 0.15 | 0.10 | 6.87 | 10.05 | 82.3 | 7.35 | 18 | 12 | 0.31 |
| TCH km 24.8 (TCHGlacier_19.0) | 0.10 | 0.10 | 4.15 | 13.42 | 102.8 | 6.80 | 67 | 41 | - |
| TCH km 25.7 (TCHGlacier_18.0) | 0.15 | 0.10 | 6.00 | 12.94 | 104.0 | 7.19 | 47 | 30 | 0.59 |
| TCH km 25.8 (TCHGlacier_17.9) | 0.10 | 0.10 | 4.76 | 11.40 | 88.8 | 7.12 | 88 | 54 | - |
| TCH km 27.1 (TCHGlacier_16.6) | 0.20 | 0.20 | 6.73 | 10.33 | 84.6 | 7.48 | 215 | - | - |

Note: DO = dissolved oxygen; - = not recorded; µS/cm = microsiemens per centimetre.



APPENDIX B

TCH km 20.6 to km 28.3 Crossing Location Summary



TRANSCANADA HIGHWAY IMPROVEMENT PROJECT, GLACIER NATIONAL PARK

Appendix B: Construction Summary for each Crossing Location along the TCH from km 20.6 to km 28.3

| Crossing Location (Culvert Name) | Crossing Type | Proposed Construction Activity | Reduced Risk Timing Window | Recommended Mitigations | DFO Request for Review Required |
|---|-------------------------------|--|--|--|---------------------------------|
| TCH km 20.76 (TCHGlacier_23.0) | Watercourse (Fish Habitat) | TCH Widening. Culvert extension on upstream westbound side of TCH. 10 m extension of the 1,200 mm culvert on the inlet with rip rap added for support and stabilization. Some inlet work may be required. | June 1 to August 31 | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to fish and fish habitat, which will be incorporated into the EPP. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ The site-specific culvert designs will consider the site-specific fish passage requirements and will be designed to enhance fish access. ■ Any additional mitigations required, from the MRG Field Unit and DFO review of the culvert designs, will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ Work outside of the June 1 to August 31 reduced risk timing window only if approved by the MRG Field Unit. ■ Water diversions will require a Restricted Activity Permit (RAP) and must include screened intakes consistent with DFO Freshwater Intake End-of-Pipe Fish Screen Guidelines. ■ Fish will only be salvaged by a QEP in accordance with the authorizations and permits issued for the associated site-specific work activities. ■ An instream suspended sediment monitoring program will be implemented. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | Yes |
| TCH km 20.94 (TCHGlacier_22.8) and km 20.91 | Watercourse (No Fish Habitat) | TCH Widening. (Culvert A1): Installment of a new culvert under the access road. 900 mm culvert that will be 36 m and will have an additional 6.1 m ³ of rip rap added for support and stabilization. (Culvert #A2): Culvert replacement/extension under TCH. 900 mm culvert that will be 42 m in total length than the existing culvert, and will have an additional 6.1 m ³ of rip rap added for support and stabilization. | None. If water is flowing during construction, instream work will be isolated to prevent suspended sediment transport to Connaught Creek. Flows will be diverted around the isolation work and continue to flow downstream. | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ Any additional mitigations required, from the MRG Field Unit review of the culvert designs, will be incorporated into the EPP. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to any downstream fish and fish habitat, which will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | No |
| TCH km 21.06 (Hermit Creek) | Watercourse (Fish Habitat) | TCH Widening. Culvert #1: Culvert replacement/extension under TCH. 50 m long, 3 m wide x 2.44 m high, Precast Concrete Box Culvert. Mixed gravel, cobble and boulder substrates, with additional rip rap added for support and stabilization. | June 1 to August 31 | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to fish and fish habitat, which will be incorporated into the EPP. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ The site-specific culvert designs will consider the site-specific fish passage requirements and will be designed to enhance fish access. ■ Any additional mitigations required, from the MRG Field Unit and DFO review of the culvert designs, will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ Work outside of the June 1 to August 31 reduced risk timing window only if approved by the MRG Field Unit. ■ Water diversions will require a Restricted Activity Permit (RAP) and must include screened intakes consistent with DFO Freshwater Intake End-of-Pipe Fish Screen Guidelines ■ Fish will only be salvaged by a QEP in accordance with the authorizations and permits issued for the associated site-specific work activities. ■ An instream suspended sediment monitoring program will be implemented. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | Yes |



TRANSCANADA HIGHWAY IMPROVEMENT PROJECT, GLACIER NATIONAL PARK

Appendix B: Construction Summary for each Crossing Location along the TCH from km 20.6 to km 28.3

| Crossing Location (Culvert Name) | Crossing Type | Proposed Construction Activity | Reduced Risk Timing Window | Recommended Mitigations | DFO Request for Review Required |
|--|-------------------------------|---|--|---|---------------------------------|
| TCH km 21.25 (TCHGlacier_22.5) | Watercourse (Fish Habitat) | TCH Widening. Culvert #2 and #3: Culvert replacement/extension under TCH. Extend the inlet side (upstream westbound side of TCH) of both of these culverts by 13.8 m with an additional 5 m ³ of rip rap added for support and stabilization. | June 1 to August 31 | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to fish and fish habitat, which will be incorporated into the EPP. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ The site-specific culvert designs will consider the site-specific fish passage requirements and will be designed to enhance fish access. ■ Any additional mitigations required, from the MRG Field Unit and DFO review of the culvert designs, will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ Work outside of the June 1 to August 31 reduced risk timing window only if approved by the MRG Field Unit. ■ Water diversions will require a Restricted Activity Permit (RAP) and must include screened intakes consistent with DFO Freshwater Intake End-of-Pipe Fish Screen Guidelines ■ Fish will only be salvaged by a QEP in accordance with the authorizations and permits issued for the associated site-specific work activities. ■ An instream suspended sediment monitoring program will be implemented. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | Yes |
| TCH km 22.05 (No named culvert/stream) | Watercourse (No Fish Habitat) | TCH Widening. No culvert replacement/extension under TCH. | None. If water is flowing during construction, instream work will be isolated to prevent suspended sediment transport to Connaught Creek. Flows will be diverted around the isolation work and continue to flow downstream. | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ Any additional mitigations required, from the MRG Field Unit review of the culvert designs, will be incorporated into the EPP. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to any downstream fish and fish habitat, which will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | No |
| TCH km 22.15 (TCHGlacier_21.6) | Watercourse (No Fish Habitat) | TCH Widening. Culvert #4: Culvert replacement/extension under TCH. Extension of the inlet side (upstream westbound side of TCH) of the 800 mm culvert by 3 m with an additional 2.3 m ³ of rip rap added for support and stabilization. | None. If water is flowing during construction, instream work will be isolated to prevent suspended sediment transport to Connaught Creek. Flows will be diverted around the isolation work and continue to flow downstream. | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ Any additional mitigations required, from the MRG Field Unit review of the culvert designs, will be incorporated into the EPP. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to any downstream fish and fish habitat, which will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | No |



TRANSCANADA HIGHWAY IMPROVEMENT PROJECT, GLACIER NATIONAL PARK

Appendix B: Construction Summary for each Crossing Location along the TCH from km 20.6 to km 28.3

| Crossing Location (Culvert Name) | Crossing Type | Proposed Construction Activity | Reduced Risk Timing Window | Recommended Mitigations | DFO Request for Review Required |
|--|-------------------------------|---|--|--|---------------------------------|
| TCH km 22.3 (Connaught Creek, TCHGlacier_21.5) | Watercourse (Fish Habitat) | TCH Widening. Culvert #5 and #C: Culvert replacement/extension under TCH. 65.2 m long, 5 m wide x 3 m high, Precast Concrete Box Culvert. Mixed gravel, cobble and boulder substrates. The existing culvert (Culvert #5) inlet extended by 3.4 m. Three new culverts (Culverts #B, #D and #E) will be installed around the proposed vehicle ponding area. | June 1 to August 31 | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to fish and fish habitat, which will be incorporated into the EPP. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ The site-specific culvert designs will consider the site-specific fish passage requirements and will be designed to enhance fish access. ■ Any additional mitigations required, from the MRG Field Unit and DFO review of the culvert designs, will be incorporated into the EPP. ■ An additional BIA is being completed for the Connectivity Restoration Work at Connaught Creek and further mitigations will be included in that BIA. Any additional mitigations will be followed during construction and will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ Work outside of the June 1 to August 31 reduced risk timing window only if approved by the MRG Field Unit. ■ Water diversions will require a Restricted Activity Permit (RAP) and must include screened intakes consistent with DFO Freshwater Intake End-of-Pipe Fish Screen Guidelines. ■ Fish will only be salvaged by a QEP in accordance with the authorizations and permits issued for the associated site-specific work activities. ■ An instream suspended sediment monitoring program will be implemented. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | Yes |
| TCH km 23.2 (TCHGlacier_20.6) | Watercourse (Fish Habitat) | TCH Widening. Culvert #6: Culvert replacement/extension under TCH. Extension of the inlet side (upstream westbound side of TCH) of the culvert by 4.7 m with an additional 7.6 m ³ of rip rap added for support and stabilization. | June 1 to August 31 | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to fish and fish habitat, which will be incorporated into the EPP. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ The site-specific culvert designs will consider the site-specific fish passage requirements and will be designed to enhance fish access. ■ Any additional mitigations required, from the MRG Field Unit and DFO review of the culvert designs, will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ Work outside of the June 1 to August 31 reduced risk timing window only if approved by the MRG Field Unit. ■ Water diversions will require a Restricted Activity Permit (RAP) and must include screened intakes consistent with DFO Freshwater Intake End-of-Pipe Fish Screen Guidelines ■ Fish will only be salvaged by a QEP in accordance with the authorizations and permits issued for the associated site-specific work activities. ■ An instream suspended sediment monitoring program will be implemented. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | Yes |
| TCH km 23.4 (TCHGlacier_20.7) | Watercourse (No Fish Habitat) | TCH Widening. Culvert #7: Culvert replacement/extension under TCH. Extension of the inlet side (upstream westbound side of TCH) of the culvert by 1.3 m with an additional 10.9 m ³ of rip rap added for support and stabilization. | None. If water is flowing during construction, instream work will be isolated to prevent suspended sediment transport to Rogers Creek. Flows will be diverted around the isolation work and continue to flow downstream. | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ Any additional mitigations required, from the MRG Field Unit review of the culvert designs, will be incorporated into the EPP. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to any downstream fish and fish habitat, which will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | No |



TRANSCANADA HIGHWAY IMPROVEMENT PROJECT, GLACIER NATIONAL PARK

Appendix B: Construction Summary for each Crossing Location along the TCH from km 20.6 to km 28.3

| Crossing Location (Culvert Name) | Crossing Type | Proposed Construction Activity | Reduced Risk Timing Window | Recommended Mitigations | DFO Request for Review Required |
|----------------------------------|--------------------------------|--|--|---|---------------------------------|
| TCH km 23.6 (TCHGlacier_20.2) | Watercourse (No Fish Habitat) | TCH Widening. Culvert #8: Culvert replacement/extension under TCH. Extension of the outlet side (downstream eastbound side of TCH) of the culvert by 4.5 m with an additional 6.1 m ³ of rip rap added for support and stabilization. | None. If water is flowing during construction, instream work will be isolated to prevent suspended sediment transport to Rogers Creek. Flows will be diverted around the isolation work and continue to flow downstream. | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ Any additional mitigations required, from the MRG Field Unit review of the culvert designs, will be incorporated into the EPP. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to any downstream fish and fish habitat, which will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | No |
| TCH km 23.84 (TCHGlacier_19.9) | Watercourse (No Fish Habitat) | TCH Widening. Culvert #9: Culvert replacement/extension under TCH. Extension of the outlet side (downstream eastbound side of TCH) of the culvert by 9.7 m with an additional 6.1 m ³ of rip rap added for support and stabilization. | None. If water is flowing during construction, instream work will be isolated to prevent suspended sediment transport to Rogers Creek. Flows will be diverted around the isolation work and continue to flow downstream. | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ Any additional mitigations required, from the MRG Field Unit review of the culvert designs, will be incorporated into the EPP. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to any downstream fish and fish habitat, which will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | No |
| TCH km 23.94 (TCHGlacier_19.8) | Watercourse (No Fish Habitat) | TCH Widening. Culvert #10: Culvert replacement/extension under TCH. Extension of both ends of this culvert by 2.5 m on the upstream inlet side and 9.7 m on the downstream outlet side with an additional 6.1 m ³ of rip rap added for support and stabilization. | None. If water is flowing during construction, instream work will be isolated to prevent suspended sediment transport to Rogers Creek. Flows will be diverted around the isolation work and continue to flow downstream. | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ Any additional mitigations required, from the MRG Field Unit review of the culvert designs, will be incorporated into the EPP. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to any downstream fish and fish habitat, which will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | No |
| TCH km 24.15 (TCHGlacier_19.6) | No Watercourse or Fish Habitat | TCH Widening. Two new culverts will be installed within the improvements area (Culverts F and G, however these will drain surface runoff from the improvement area only. | None. If water is flowing within this ditch at the time of construction, all construction works within the flow path of this drainage will be isolated to prevent suspended sediment transport to the downstream unnamed tributary of the Illecillewaet River. Flows will be diverted around the isolation work and continue to flow downstream, unimpeded and uncontaminated. | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. ■ Any additional mitigations required, from the MRG Field Unit review of the culvert designs, will be incorporated into the EPP. ■ If water is flowing at the time of construction, all construction works within the flow path of this drainage will be isolated to prevent suspended sediment transport to the downstream watercourse. In addition, flows will be diverted around the isolation work, in accordance with the specifications under the BMP, and will continue to flow downstream, unimpeded and uncontaminated. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | No |



TRANSCANADA HIGHWAY IMPROVEMENT PROJECT, GLACIER NATIONAL PARK

Appendix B: Construction Summary for each Crossing Location along the TCH from km 20.6 to km 28.3

| Crossing Location (Culvert Name) | Crossing Type | Proposed Construction Activity | Reduced Risk Timing Window | Recommended Mitigations | DFO Request for Review Required |
|---|-------------------------------|--|--|--|---------------------------------|
| TCH km 24.6 (TCHGlacier_19.2) | Watercourse (Fish Habitat) | TCH Widening. Culvert #11: Culvert replacement/extension under TCH. 1,200 mm culvert which will be 12 m on either side of the TCH and will have an additional 10.8 m ³ of rip rap. | June 1 to August 31 | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to fish and fish habitat, which will be incorporated into the EPP. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ The site-specific culvert designs will consider the site-specific fish passage requirements and will be designed to enhance fish access. ■ Any additional mitigations required, from the MRG Field Unit and DFO review of the culvert designs, will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ Work outside of the June 1 to August 31 reduced risk timing window only if approved by the MRG Field Unit. ■ Water diversions will require a Restricted Activity Permit (RAP) and must include screened intakes consistent with DFO Freshwater Intake End-of-Pipe Fish Screen Guidelines ■ Fish will only be salvaged by a QEP in accordance with the authorizations and permits issued for the associated site-specific work activities. ■ An instream suspended sediment monitoring program will be implemented. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | Yes |
| TCH km 24.8 (TCHGlacier_19.0) | Watercourse (Fish Habitat) | TCH Widening. Culvert #12: Culvert replacement/extension under TCH. 900 mm culvert which will be 12 m on either side of the TCH and will have an additional 6.1 m ³ of rip rap. | June 1 to August 31 | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to fish and fish habitat, which will be incorporated into the EPP. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ The site-specific culvert designs will consider the site-specific fish passage requirements and will be designed to enhance fish access. ■ Any additional mitigations required, from the MRG Field Unit and DFO review of the culvert designs, will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ Work outside of the June 1 to August 31 reduced risk timing window only if approved by the MRG Field Unit. ■ Water diversions will require a Restricted Activity Permit (RAP) and must include screened intakes consistent with DFO Freshwater Intake End-of-Pipe Fish Screen Guidelines. ■ Fish will only be salvaged by a QEP in accordance with the authorizations and permits issued for the associated site-specific work activities. ■ An instream suspended sediment monitoring program will be implemented. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | Yes |
| TCH km 24.9 (TCHGlacier_18.8) and km 25.0 | Watercourse (No Fish Habitat) | TCH Widening. Culvert #13: Culvert replacement/extension under TCH. 900 mm culvert that will be 13 m longer in total length than the existing culvert, and will have an additional 6.1 m ³ of rip rap. Culvert #14: New culvert under TCH. 6 m longer on upstream, westbound side of the TCH and 1.5 m longer on the downstream, eastbound side, and will have an additional 6.1 m ³ of rip rap. | None. If water is flowing during construction, instream work will be isolated to prevent suspended sediment transport to Illecillewaet River. Flows will be diverted around the isolation work and continue to flow downstream. | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ Any additional mitigations required, from the MRG Field Unit review of the culvert designs, will be incorporated into the EPP. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to any downstream fish and fish habitat, which will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | No |



TRANSCANADA HIGHWAY IMPROVEMENT PROJECT, GLACIER NATIONAL PARK

Appendix B: Construction Summary for each Crossing Location along the TCH from km 20.6 to km 28.3

| Crossing Location (Culvert Name) | Crossing Type | Proposed Construction Activity | Reduced Risk Timing Window | Recommended Mitigations | DFO Request for Review Required |
|----------------------------------|-------------------------------|--|---|---|---------------------------------|
| TCH km 25.1 (TCHGlacier_18.6) | Watercourse (No Fish Habitat) | TCH Widening. Culvert #15: Culvert replacement/extension under TCH. 900 mm culvert that will be 17 m longer on the downstream, eastbound side of the TCH, and will have an additional 3.3 m ³ of rip rap. | None. If water is flowing during construction, all instream work will be isolated to prevent suspended sediment transport to Illecillewaet River. Flows will be diverted around the isolation work and continue to flow downstream. | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ Any additional mitigations required, from the MRG Field Unit review of the culvert designs, will be incorporated into the EPP. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to any downstream fish and fish habitat, which will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | No |
| TCH km 25.25 (TCHGlacier_18.5) | Watercourse (No Fish Habitat) | TCH Widening. Culvert #16: Culvert replacement/extension under TCH. 900 mm culvert that will be 13 m longer on the downstream, eastbound side of the TCH, and will have an additional 3.3 m ³ of rip rap. | None. If water is flowing during construction, instream work will be isolated to prevent suspended sediment transport to Illecillewaet River. Flows will be diverted around the isolation work and continue to flow downstream. If culvert work extends into the fish-bearing tributary to the Illecillewaet River, then the June 1 to August 31 timing window applies. | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ Any additional mitigations required, from the MRG Field Unit review of the culvert designs, will be incorporated into the EPP. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to any downstream fish and fish habitat, which will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | No |
| TCH km 25.7 (TCHGlacier_18.0) | Watercourse (Fish Habitat) | TCH Widening. Culvert #17: Culvert replacement/extension under TCH. 1,800 mm culvert which will be 20 m longer in total length than the existing culvert, and will have an additional 3.3 m ³ of rip rap. | June 1 to August 31 | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to fish and fish habitat, which will be incorporated into the EPP. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ The site-specific culvert designs will consider the site-specific fish passage requirements and will be designed to enhance fish access. ■ Any additional mitigations required, from the MRG Field Unit and DFO review of the culvert designs, will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ Work outside of the June 1 to August 31 reduced risk timing window only if approved by the MRG Field Unit. ■ Water diversions will require a Restricted Activity Permit (RAP) and must include screened intakes consistent with DFO Freshwater Intake End-of-Pipe Fish Screen Guidelines ■ Fish will only be salvaged by a QEP in accordance with the authorizations and permits issued for the associated site-specific work activities. ■ An instream suspended sediment monitoring program will be implemented. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | Yes |



TRANSCANADA HIGHWAY IMPROVEMENT PROJECT, GLACIER NATIONAL PARK

Appendix B: Construction Summary for each Crossing Location along the TCH from km 20.6 to km 28.3

| Crossing Location (Culvert Name) | Crossing Type | Proposed Construction Activity | Reduced Risk Timing Window | Recommended Mitigations | DFO Request for Review Required |
|----------------------------------|-------------------------------|--|--|---|---------------------------------|
| TCH km 25.8 (TCHGlacier_17.9) | Watercourse (Fish Habitat) | TCH Widening. Culvert #18: Culvert replacement/extension under TCH. 1,000 mm culvert which will be 22.7 m longer in total length than the existing culvert, and will have an additional 13.1 m ³ of rip rap. | June 1 to August 31 | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to fish and fish habitat, which will be incorporated into the EPP. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ The site-specific culvert designs will consider the site-specific fish passage requirements and will be designed to enhance fish access. ■ Any additional mitigations required, from the MRG Field Unit and DFO review of the culvert designs, will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ Work outside of the June 1 to August 31 reduced risk timing window only if approved by the MRG Field Unit. ■ Water diversions will require a Restricted Activity Permit (RAP) and must include screened intakes consistent with DFO Freshwater Intake End-of-Pipe Fish Screen Guidelines ■ Fish will only be salvaged by a QEP in accordance with the authorizations and permits issued for the associated site-specific work activities. ■ An instream suspended sediment monitoring program will be implemented. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | Yes |
| TCH km 27.1 (TCHGlacier_16.6) | Watercourse (Fish Habitat) | TCH Widening. Culvert #24: Culvert replacement/extension under TCH. 600 mm culvert which will be 5.9 m longer in total length than the existing culvert, and will have an additional 6.6 m ³ of rip rap. | June 1 to August 31 | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to fish and fish habitat, which will be incorporated into the EPP. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ The site-specific culvert designs will consider the site-specific fish passage requirements and will be designed to enhance fish access. ■ Any additional mitigations required, from the MRG Field Unit and DFO review of the culvert designs, will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ Work outside of the June 1 to August 31 reduced risk timing window only if approved by the MRG Field Unit. ■ Water diversions will require a Restricted Activity Permit (RAP) and must include screened intakes consistent with DFO Freshwater Intake End-of-Pipe Fish Screen Guidelines ■ Fish will only be salvaged by a QEP in accordance with the authorizations and permits issued for the associated site-specific work activities. ■ An instream suspended sediment monitoring program will be implemented. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | Yes |
| TCH km 27.25 (TCHGlacier_16.4) | Watercourse (No Fish Habitat) | TCH Widening. Culvert #25: Culvert replacement/extension under TCH. 900 mm culvert that will be 5.53 m longer on the downstream, westbound side of the TCH, and will have an additional 3.3 m ³ of rip rap. | <p>None.</p> <p>If water is flowing during construction, instream work will be isolated to prevent suspended sediment transport to Illecillewaet River. Flows will be diverted around the isolation work and continue to flow downstream.</p> <p>If culvert work extends into Illecillewaet River, then the June 1 to August 31 timing window applies.</p> | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ Any additional mitigations required, from the MRG Field Unit review of the culvert designs, will be incorporated into the EPP. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to any downstream fish and fish habitat, which will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | No |



TRANSCANADA HIGHWAY IMPROVEMENT PROJECT, GLACIER NATIONAL PARK

Appendix B: Construction Summary for each Crossing Location along the TCH from km 20.6 to km 28.3

| Crossing Location (Culvert Name) | Crossing Type | Proposed Construction Activity | Reduced Risk Timing Window | Recommended Mitigations | DFO Request for Review Required |
|---------------------------------------|--------------------------------|---|---|---|---------------------------------|
| TCH km 27.5 (TCHGlacier_16.2) | Watercourse (No Fish Habitat) | TCH Widening. Culvert #26: Culvert replacement/extension under TCH. 800 mm culvert that will be 5.5 m longer on the downstream, westbound side of the TCH, and will have an additional 12.9 m ³ of rip rap. | None. If water is flowing during construction, instream work will be isolated to prevent suspended sediment transport to Illecillewaet River. Flows will be diverted around the isolation work and continue to flow downstream. | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ Any additional mitigations required, from the MRG Field Unit review of the culvert designs, will be incorporated into the EPP. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to any downstream fish and fish habitat, which will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | No |
| TCH km 27.6 (TCHGlacier_16.1) | Watercourse (No Fish Habitat) | TCH Widening. Culvert #27: Culvert replacement/extension under TCH. 1,200 mm culvert that will be 6.1 m longer on the downstream, westbound side of the TCH, and will have an additional 22.1 m ³ of rip rap. | None. If water is flowing during construction, instream work will be isolated to prevent suspended sediment transport to Illecillewaet River. Flows will be diverted around the isolation work and continue to flow downstream. | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ Any additional mitigations required, from the MRG Field Unit review of the culvert designs, will be incorporated into the EPP. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to any downstream fish and fish habitat, which will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | No |
| TCH km 27.9 (TCHGlacier_15.8) | No Watercourse or Fish Habitat | TCH Widening. No culvert replacement/extension under TCH. | None. If water is flowing within this ditch at the time of construction, all construction works within the flow path of this drainage will be isolated to prevent suspended sediment transport to the downstream unnamed tributary of the Illecillewaet River. Flows will be diverted around the isolation work and continue to flow downstream, unimpeded and uncontaminated. | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. ■ Any additional mitigations required, from the MRG Field Unit review of the culvert designs, will be incorporated into the EPP. ■ If water is flowing at the time of construction, all construction works within the flow path of this drainage will be isolated to prevent suspended sediment transport to the downstream watercourse. In addition, flows will be diverted around the isolation work, in accordance with the specifications under the BMP, and will continue to flow downstream, unimpeded and uncontaminated. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | No |
| TCH km 28.0 (No named culvert/stream) | Watercourse (No Fish Habitat) | TCH Widening. Culvert P4 & P5: Culvert replacement/extension under TCH. 900 mm and 600 mm set of culverts, which will be 60 m and 19.6 m in respective length; these culverts will be installed on the upstream, eastbound side of the TCH, and will have 5.9 m ³ and 8.7 m ³ of rip rap | None. If water is flowing during construction, instream work will be isolated to prevent suspended sediment transport to Illecillewaet River. Flows will be diverted around the isolation work and continue to flow downstream. | <ul style="list-style-type: none"> ■ BIA recommendations for Surface Water Quality, Fish and Fish Habitat. ■ PCA BMPs for roadway, highway, parkway and related infrastructure mitigations will be followed. ■ Culverts will be specifically designed and placed so as not to impede flows. All existing culverts that are currently hanging (perched), or impeding flows will be repaired or replaced. Where applicable, flows and channel stabilization will be improved through culvert design and placement. ■ Any additional mitigations required, from the MRG Field Unit review of the culvert designs, will be incorporated into the EPP. ■ Complete construction in accordance with applicable regulatory (MRG Field Unit and DFO) measures to avoid causing harm to any downstream fish and fish habitat, which will be incorporated into the EPP. ■ During construction, the instream work area will be isolated from flowing water, with flows being diverted around the portion of the watercourse where work is taking place. ■ Where possible, undertake works during periods of dry weather, outside of the freshet period, as this allows easier control of runoff and sediment. ■ During construction the MRG Field Unit be on-site as QEP/ESO to ensure that all mitigations specified in the EPP, are implemented. In the event that PCA staff are not available during construction, a QEP/ESO will be contracted to conduct monitoring during construction. | No |



Appendix B: Construction Summary for each Crossing Location along the TCH from km 20.6 to km 28.3

| Crossing Location (Culvert Name) | Crossing Type | Proposed Construction Activity | Reduced Risk Timing Window | Recommended Mitigations | DFO Request for Review Required |
|----------------------------------|--------------------------------|-------------------------------------|----------------------------|-------------------------|---------------------------------|
| TCH km 28.5 (TCHGlacier_15.1) | No Watercourse or Fish Habitat | No construction activities planned. | Not Applicable. | ■ Not Applicable. | No |
| TCH km 28.7 (TCHGlacier_15.0) | Watercourse (No Fish Habitat) | No construction activities planned. | Not Applicable. | ■ Not Applicable. | No |
| TCH km 28.8 (TCHGlacier_14.8) | Watercourse (No Fish Habitat) | No construction activities planned. | Not Applicable. | ■ Not Applicable. | No |

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

For more information, visit golder.com

| | |
|---------------|-------------------|
| Africa | + 27 11 254 4800 |
| Asia | + 86 21 6258 5522 |
| Australasia | + 61 3 8862 3500 |
| Europe | + 44 1628 851851 |
| North America | + 1 800 275 3281 |
| South America | + 56 2 2616 2000 |

solutions@golder.com
www.golder.com

Golder Associates Ltd.
102, 2535 - 3rd Avenue S.E.
Calgary, Alberta, T2A 7W5
Canada
T: +1 (403) 299 5600

