

February 4, 2020

BC Environmental Assessment Office
2nd Floor, 836 Yates Street
P.O. Box 9426 Stn Prov Govt
Victoria, BC V8W 9V1b
Attention: Heidi Gibson, Executive Project Director,
Power and Infrastructure

Dear Heidi Gibson:

Re: Environmental Assessment Certificate (EAC) #E14-02: Schedule A (Project Description) & Design of Highway 29 Crossings at Farrell Creek, Dry Creek and Lynx Creek – Proposed Amendments

1. INTRODUCTION

Highway 29 is a two-lane highway connecting Hudson's Hope to Fort St. John along the north side of the Peace River. Segments of the highway will be inundated by the reservoir for the Site C Clean Energy Project (the Project), resulting in the need to realign approximately 30 km of existing highway at Bear Flat/Cache Creek, Halfway River, Farrell Creek, Dry Creek and Lynx Creek. The locations of these realignment segments are shown in each Figure 1 of Appendices A, B and C.

The purpose of this letter is to seek amendments to Section 4.3.4.1 (Table 4.5) in Schedule A of the Project's Environmental Assessment Certificate #E14-02 ("EAC"). These amendments relate to changes in the design of the Highway 29 crossings for Farrell Creek, Dry Creek and Lynx Creek which have been made based on information obtained through geotechnical investigations and stability analyses. Specifically, BC Hydro proposes that:

- a long bridge design replace the causeway and short bridge design currently approved for Farrell Creek
- a bridge replace the culvert currently approved for Dry Creek, and
- a same length causeway and longer bridge replace the causeway and bridge currently approved for Lynx Creek

Information in this letter is provided in accordance with section 32 of the *Environmental Assessment Act* and section 7(4) of the EAC. This letter and attached Appendices A, B and C provide descriptions of the Farrell Creek, Dry Creek and Lynx Creek crossings respectively, including:

- The difference between the Project Description in Schedule A and the proposed revised designs
- The impact of the revised designs to relevant valued components as assessed in the Project's Environmental Impact Statement (EIS)
- Studies on the designs submitted during the environmental assessment
- Indigenous group consultation on the requested amendments
- Government approvals related to the requested amendments

Appendix D, Proposed Revisions to EAC Schedule A, provides a redline version of the changes requested. Overall, the proposed design changes for the three crossings are not expected to cause any adverse effects on valued components beyond the effects that were considered during the environmental assessment of the Project. The proposed changes are expected to provide several benefits, including increased safety and stability of the crossings, and have smaller or similar aquatic and terrestrial footprints as the EAC approved crossings.

2. REQUESTED AMENDMENTS TO EAC SCHEDULE A

Rationale for Requested Amendments

As described in Section 4.3.4.2 of EAC Schedule A, a number of highway alignment alternatives were assessed for each of the Highway 29 realignment segments. Each alternative was evaluated in terms of relative safety, environmental effects (including those on fish, wildlife, and habitat), social effects (including those on property, heritage, and agriculture), and costs.

Since Schedule A was issued, BC Hydro and its design engineering teams have continued to work on the design of the Highway 29 realignments. In mid-2018, BC Hydro undertook geotechnical investigations to obtain additional information on site conditions. Further design analysis was also undertaken, resulting in the following design changes:

- **Farrell Creek Crossing:** Geotechnical investigations indicated that a zone of weathered shale exists between sand / gravel layers and shale bedrock at the Farrell Creek crossing. Given this information, geotechnical engineers determined that the planned causeway could only be made safe by flattening the causeway slopes and excavating and replacing the weak foundation soils with granular material. BC Hydro determined that this approach was not viable due to (a) a potential lack of locally sourced borrow and granular material; (b) slow construction progress due to additional excavation and foundation fills; and (c) associated construction costs. In the spring of 2019, BC Hydro therefore determined that the most cost effective alternative was to eliminate the short bridge plus causeway option, and to pursue a long bridge option, with conceptual parameters as described in Table 1: a bridge up to 450m in length, no causeway, and up to six piers.
- **Dry Creek Crossing:** Geotechnical investigations indicated that subsurface conditions were not conducive to the construction of the pipe-arch culvert as described in the EAC. A slope stability analysis revealed that the settlement criteria for the pipe-arch culvert could not be achieved without significant excavation of the foundation soils or the installation of deep piled foundations. Alternative bridge crossings were therefore assessed and evaluated based on several criteria, including road safety, hydrotechnical, structural, geotechnical, environmental, constructability, maintenance and overall cost. In the spring of 2019, BC Hydro determined that the most efficient alternative crossing at Dry Creek was a short bridge with conceptual parameters as described in Table 1: a bridge up to 200m and up to 3 piers.
- **Lynx Creek Crossing:** Refinements to the causeway and bridge lengths at the Lynx Creek Crossing were made through the design process to minimize elevation changes between the east and west approaches. The proposed revised causeway will remain the same length, and the bridge length will be up to 20m longer than the EAC design. These changes are required to

maximize sight distances along this segment of the highway, while also ensuring MOTI standards and guidelines for safety are met.

Requested Amendments

Table 1 summarizes the requested amendments to EAC Schedule A. As shown in Table 1, BC Hydro is also proposing to amend Figures 4.28, 4.29, and 4.30 to reflect the revised designs for each crossing. These figures are attached in Appendices A, B and C for the Farrell Creek, Dry Creek and Lynx Creek crossings respectively.

Table 1. Requested Amendments to EAC Schedule A

Component	Text from EAC Schedule A Project Description	Requested Amendments to Schedule A Project Description
Highway 29 Realignment Farrell Creek Crossing	Section 4.3.4.1, Table 4.5: Highway 29 Realignment Segments and Respective Watercourse Crossing Lengths For Farrell Creek: Total Length of Segment: 2.0 km Causeway Length: 150 m Bridge Length: 170 m Number of Piers: N/A ¹ Number of Bridge Spans: 2 Figure Number: Figure 4.30 Rev 0	Section 4.3.4.1, Table 4.5: Highway 29 Realignment Segments and Respective Watercourse Crossing Lengths For Farrell Creek: Total Length of Segment: 2.0 km Causeway Length: 0 m Bridge Length: up to 450 m Number of Piers: up to 6 Number of Bridge Spans: up to 7 Figure Number: Figure 4.30 Rev 1
Highway 29 Realignment Dry Creek Crossing	Section 4.3.4.1, Table 4.5: Highway 29 Realignment Segments and Respective Watercourse Crossing Lengths For Dry Creek: Total Length of Segment: 1.5 km Causeway Length: N/A ² Bridge Length: 11 m pipe-arch culvert Number of Piers: N/A Number of Bridge Spans: N/A Figure Number: Figure 4.29 Rev 0	Section 4.3.4.1, Table 4.5: Highway 29 Realignment Segments and Respective Watercourse Crossing Lengths For Dry Creek: Total Length of Segment: 1.5 km Causeway Length: 0 m Bridge Length: up to 200 m Number of Piers: up to 3 Number of Bridge Spans: up to 4 Figure Number: Figure 4.29 Rev 1

¹ Table 4.5 in the EAC notes that the number of piers for the Farrell Creek Crossing is “N/A”. However, EAC Figure 4.30 Rev 0 shows one pier.

² Table 4.5 in the EAC notes that the causeway length for Dry Creek is “N/A”. However, approximately 1.7 ha of fill material would be placed in the Dry Creek valley for the culvert installation.

Component	Text from EAC Schedule A Project Description	Requested Amendments to Schedule A Project Description
Highway 29 Realignment Lynx Creek Crossing	Section 4.3.4.1, Table 4.5: Highway 29 Realignment Segments and Respective Watercourse Crossing Lengths For Lynx Creek: Total Length of Segment: 8.0 km Causeway Length: 290 m Bridge Length: 160 m Number of Piers: 1 Number of Bridge Spans: 2 Figure Number: Figure 4.28 Rev 0	Section 4.3.4.1, Table 4.5: Highway 29 Realignment Segments and Respective Watercourse Crossing Lengths For Lynx Creek: Total Length of Segment: 8.0 km Causeway Length: up to 290 m Bridge Length: up to 180 m Number of Piers: up to 3 Number of Bridge Spans: up to 4 Figure Number: Figure 4.28 Rev 1

Assessment of Amendments

Appendices A, B and C provide information on the Farrell Creek, Dry Creek and Lynx Creek crossings respectively, including a description of crossing construction, assessment of potential impacts on valued components resulting from the design changes, and related provincial and federal government approvals/permits. As noted above, the proposed design changes for the three crossings are not expected to cause any adverse effects on valued components beyond the effects that were considered and approved during the environmental assessment of the Project.

3. RELATED STUDIES SUBMITTED DURING THE ENVIRONMENTAL ASSESSMENT

The following sections of the EIS provide additional information regarding the effects of the Highway 29 realignment for the Site C Project:

- Fish and Fish Habitat – EIS Volume 2, Section 12
- Vegetation and Ecological Communities – EIS Volume 2, Section 13
- Wildlife Resources – EIS Volume 2, Section 14
- Current Use of Lands and Resources for Traditional Purposes – EIS Volume 3, Section 19
- Harvest of Fish and Wildlife Resources – EIS Volume 3, Section 24
- Navigation – EIS Volume 3, Section 26
- Heritage Resources – EIS Volume 4, Section 32

4. INDIGENOUS GROUP CONSULTATION/ENGAGEMENT

Environmental Assessment

The Highway 29 realignments, including crossings at Farrell Creek, Dry Creek and Lynx Creek, were described in the Project's EIS. During the environmental assessment process for the Project, Indigenous groups provided feedback on the EIS, and through traditional land use studies, identified concerns regarding potential effects of the Project on fishing, hunting, trapping and other cultural and traditional uses of land and resources. Comments provided by Indigenous groups on the EIS, including concerns

regarding the Highway 29 realignment, and BC Hydro's responses, are available on the EAO's website for the project.³

BC Hydro has invited Indigenous groups to ground truth Highway 29 realignment areas, including Farrell Creek, Dry Creek and Lynx Creek, and we will continue to work with interested Indigenous groups in this area with the goal of mitigating any site-specific concerns.

EAC Amendment Request

BC Hydro's draft request to EAO to amend Section 4.3.4.1, Table 4.5 of Schedule A, EAC #E14-02 was provided to the following Indigenous groups on January 6, 2019: Blueberry River First Nations, Dene Tha' First Nation, Doig River First Nation, Duncan's First Nation, Fort Nelson First Nation, Horse Lake First Nation, Kelly Lake Métis Settlement Society, McLeod Lake Indian Band, Métis Nation British Columbia, Prophet River First Nation, Saulteau First Nations and West Moberly First Nations. BC Hydro requested that Indigenous groups provide comments by January 31, 2020 and offered to meet to review the draft amendment request. Indigenous groups were advised that their input would inform the final amendment request to be submitted in early February 2020.

BC Hydro did not receive any written comments from Indigenous groups on the draft EAC amendment request. On January 17, 2020, BC Hydro met with Saulteau First Nations to discuss the proposed amendments. Saulteau First Nations expressed an interest in the potential impacts of the design changes to fish. BC Hydro indicated that the removal of the causeway at Farrell Creek and the culvert at Dry Creek, and replacing these structures with bridges, would result in a smaller footprint and impact on fish and fish habitat.

BC Hydro also discussed the design for the Highway 29 realignment at Farrell Creek during a permitting forum with Indigenous groups on November 14, 2019. BC Hydro indicated that we would be seeking an EAC amendment to reflect the design changes that were presented at the forum. No questions regarding the EAC amendment were raised. The design for the Highway 29 realignments at Dry Creek and Lynx Creek will be discussed at a permitting forum scheduled for February 20, 2020.

Regulatory and compliance matters for BC Hydro's northeast projects (including Site C) are discussed during regular meetings with some BC Treaty 8 First Nations. Upon request, the Farrell Creek, Dry Creek, and Lynx Creek EAC amendment requests will also be introduced and discussed at meetings scheduled for the spring 2020.

5. ATTACHMENTS

Appendix A

- Proposed Revision to Farrell Creek Crossing

Appendix B:

- Proposed Revision to Dry Creek Crossing

³ The table of Information Requests from Indigenous groups and BC Hydro's responses can be found at <https://projects.eao.gov.bc.ca/api/document/5887e157d876de1347b51259/fetch>

Appendix C:

- Proposed Revision to Lynx Creek Crossing

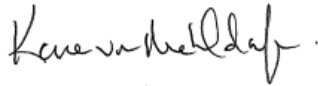
Appendix D

- Extract of EAC #E14-02 Schedule A showing the changes proposed by this amendment request in redline.

6. CLOSURE

I trust this submission provides useful information regarding BC Hydro's request to amend Section 4.3.4.1, Table 4.5 of Schedule A, EAC #E14-02. We look forward to discussing this amendment with you further. In the meantime, please don't hesitate to contact me if you have any questions or comments.

Regards,



Karen von Muehldorfer
Regulatory Manager
Site C Clean Energy Project
Karen.vonMuehldorfer@bchydro.com

Cc: Shanna Mason, Environment, Permitting and Community Benefits Director, BC Hydro
Heather Noble, Project Assessment Director, EAO
Stasia Ferbey, Project Assessment Officer, EAO

Appendix A
Supporting Information for Proposed Schedule A Revisions
Farrell Creek Crossing

1. PROPOSED AMENDMENTS TO EAC SCHEDULE A, TABLE 4.5

The location of the Highway 29 crossing at Farrell Creek is shown on Appendix A, Figure 1.

BC Hydro is proposing to replace the EAC approved short bridge plus causeway option with a long bridge without a causeway that will be up to 450m long. BC Hydro is therefore requesting the following revisions to EAC Schedule A, Section 4.3.4.1, Table 4.5:

Component	Text from EAC Schedule A Project Description	Requested Amendments to Schedule A Project Description
Highway 29 Realignment	Section 4.3.4.1, Table 4.5: Highway 29 Realignment Segments and Respective Watercourse Crossing Lengths	Section 4.3.4.1, Table 4.5: Highway 29 Realignment Segments and Respective Watercourse Crossing Lengths
Farrell Creek Crossing	For Farrell Creek: Total Length of Segment: 2.0 km Causeway Length: 150 m Bridge Length: 170 m Number of Piers: N/A ⁴ Number of Bridge Spans: 2 Figure Number: Figure 4.30 Rev 0 (attached as Appendix A, Figure 2)	For Farrell Creek: Total Length of Segment: 2.0 km Causeway Length: 0 m Bridge Length: up to 450 m Number of Piers: up to 6 Number of Bridge Spans: up to 7 Figure Number: Figure 4.30 Rev 1 (attached as Appendix A, Figure 3)

As shown in Figures 2, 3 and 6, the proposed design changes to the crossing will not materially change the alignment of the crossing, with the revised bridge design a few degrees offset from the EAC approved causeway. Overall, the removal of the causeway will reduce the environmental impact of construction below the future reservoir during the years leading up to inundation.

2. FARRELL CREEK BRIDGE CONSTRUCTION

Typical bridge construction practices, including the use of temporary laydown areas off the ends of the bridge, may be developed by the contractor to facilitate highway and bridge construction. By replacing the causeway with a longer bridge, BC Hydro will reduce the need to excavate and haul materials from external sources. Material required for highway embankments will be sourced locally from areas that will be inundated by the future reservoir, and potentially from future areas that will not be inundated by the future reservoir.

A concrete batch plant may be setup to produce concrete for the Farrell Creek Bridge. Steel piles and girders required in the bridge construction will be manufactured at, and delivered from, off-site facilities. Early in the construction of the Farrell Creek Bridge, approximately 250m of the existing Farrell Creek channel will be bermed to contain the creek to a defined channel, to facilitate construction of granular berms at the base of the west and east slopes of the Farrell Creek valley. These containment berms will be in-place until reservoir filling, currently scheduled for September 2023.

⁴ Table 4.5 in the EAC notes that the number of piers for the Farrell Creek Crossing is "N/A". However, EAC Figure 4.30 Rev 0 shows one pier.

3. IMPACT TO VALUED COMPONENTS

The differences between the proposed revised design and the approved design in EAC Schedule A are not anticipated to cause any adverse effects on valued components beyond the effects that were considered and approved during the environmental assessment of the Project. For this assessment, the following valued components were reviewed and are described below: fish and fish habitat, vegetation and ecological communities, wildlife resources, harvest of fish and wildlife resources, current use of lands and resources for traditional purposes, navigation, and heritage resources. The following valued components were not assessed as they were determined to not interact either with the Highway 29 realignment or with the proposed revised design change to the Farrell Creek crossing: greenhouse gases, local government revenue, labour market, regional economic development, agriculture, forestry, oil, gas and energy, outdoor recreation and tourism, visual resources, population and demographics, housing, community infrastructure and services, transportation, and human health.

The assessment below is supported by information in Figures 4 and 5 – the EAC and Revised Design bridge profiles -- and Figure 6, a plan view of the EAC Schedule A bridge design versus the proposed revised design, post reservoir filling.

Fish and Fish Habitat

The effects of the Project on fish and fish habitat were assessed in the environmental assessment by considering changes to fish habitat, fish health and survival, and fish movement. As described in the EIS, the section of Farrell Creek adjacent to the realignment provides rearing and feeding habitats for sucker and minnow species, and acts as a migration corridor for fish moving between the Peace River and spawning and rearing habitats further upstream. The EIS concluded that the construction of the Highway 29 realignment at Farrell Creek would not result in a potential loss of fish habitat. The EIS also concluded that the construction of Highway 29 realignments would not result in adverse residual effects on fish health and survival or fish movement if mitigation measures, such as erosion and sediment control, are implemented.

The proposed revision to the Farrell Creek Bridge design is not anticipated to affect the conclusions of the environmental assessment regarding the effects of the Project on fish and fish habitat. Both the EAC bridge design and the proposed revised design cross Farrell Creek at a location that will be converted from stream to reservoir habitat following reservoir filling. The revised design includes an additional pier inside the present channel high-water-mark, but the elimination of the causeway will result in an overall reduced aquatic footprint. The causeway would have required substantial fill placement in and around the present creek channel.

The containment channel to be constructed for the revised design would have also been required for the original EAC design. This channel will maintain fish access to upstream habitat throughout the construction period, and isolation of the pier works areas from flowing water.

Final design details are pending for the proposed revised bridge. A detailed assessment of the instream impacts of the piers per the final bridge design will be undertaken by a qualified environmental professional prior to construction of the bridge, in accordance with the federal *Fisheries Act*.

Vegetation and Ecological Communities and Wildlife Resources

The effects of the Highway 29 realignment on vegetation and ecological communities were assessed as part of the assessment of the effects of the Project on vegetation and ecological communities. That assessment focused on the key indicators of terrestrial ecosystems and rare plants. The effects of the Project on terrestrial ecosystems and rare plants were determined in the EIS to be significant due to Project impacts on rare ecological communities and rare plants.

The effects of the Highway 29 realignment on wildlife resources were assessed as part of the effects of the Project on wildlife resources. That assessment focused on a number of wildlife key indicators under the species groups of butterflies and dragonflies, amphibians and reptiles, migratory birds, non-migratory game birds, raptors, bats, fur-bearers, ungulates, and large carnivores. The effects of the Project on wildlife resources were determined to be significant due to the alteration and fragmentation of habitat for avian species of provincial and federal conservation concern.

The proposed modification to the Farrell Creek Bridge design is not expected to cause any additional effects on vegetation and ecological communities or wildlife resources beyond those predicted in the EIS. As shown in Figure 6, the 150m causeway per EAC Schedule A design will be replaced by piers in the proposed revised design. This change does not increase the terrestrial footprint of the Farrell Creek crossing. Therefore, this revised design would not change the conclusions of the EIS regarding vegetation and ecological communities, or wildlife resources.

Harvest of Fish and Wildlife Resources

Project effects on the harvest of fish and wildlife resources were assessed in the EIS by considering Project changes to the use of and access to hunting, fishing, trapping, and guide outfitter areas, tenure areas, or the availability of harvested species based on the results of the assessment of the Project on fish and wildlife resources. Because the proposed modified design of the Farrell Creek Bridge will not result in any additional effects on fish and fish habitat, vegetation and ecological communities, and wildlife resources, it is not expected to cause any additional effects on the harvest of fish and wildlife resources beyond those predicted in the EIS.

Current Use of Lands and Resources for Traditional Purposes

Project effects on Current Use of Lands and Resources for Traditional Purposes were assessed in the EIS by considering Project changes to current use of lands and resources for hunting, fishing and trapping activities, as well as current use of lands and resources for activities other than hunting, fishing and trapping by Indigenous groups, including cultural activities. The revised design of the Farrell Creek Bridge will result in reduced interactions with fish and fish habitat, and will not result in any additional effects on vegetation and ecological communities or wildlife resources. In addition, the revised design will not result in any additional effects on activities other than hunting, fishing or trapping by Indigenous groups, including effects on cultural activities. Therefore, the revised design is not expected to cause any additional effects on the current use of lands and resources beyond those predicted in the EIS.

Navigation

The proposed revision to the Farrell Creek Bridge design is not expected to result in any additional effects on navigation beyond those predicted in the EIS. The Farrell Creek Bridge design in EAC Schedule

A includes a single pier and a minimum navigation clearance envelope equal to 8m high (as measured from maximum normal reservoir elevation, 461.8m) and 25m wide (Figures 4 and 5). During the environmental assessment, Transport Canada provided an analysis that resulted in the recommendation that the Farrell Creek Bridge design contain a clearance envelope that is 8m high, as measured from the 461.8m reservoir elevation level, and 25m wide.⁵ The proposed revised bridge design meets these requirements.

In addition, the overall boater access beneath the bridge is expected to improve as the revised design provides a wider wetted channel in the area below the bridge deck due to the elimination of the 150m causeway described in the EAC. Navigation channel marks and boater notifications for the modified bridge would meet all requirements for compliance under the *Canadian Navigable Waters Act*. No additional restrictions to boater access are expected to result from the changes to the design. Decommissioning of the existing Farrell Creek Bridge will be confirmed through discussions with Transport Canada and the Ministry of Transportation and Infrastructure. If the structure is left in place, the bridge deck will be 10.7m below minimum normal reservoir level of 460.0 m (i.e. existing bridge deck elevation = 449.3m), which will not interfere with boater traffic.

Heritage Resources

A comprehensive Effects Assessment for Heritage Resources was undertaken for the EIS (see EIS Volume 4 Appendix C, Technical Appendix: Heritage Resource Assessment Report). Information and data for the Effects Assessment was drawn from 1) literature reviews, including palaeontological resources, archaeological resources, and historical resources, 2) consultation between BC Hydro and Indigenous groups, and 3) an extensive, multi-year field inventory and survey.

The proposed modification to the Farrell Creek Bridge design is not expected to cause any additional effects on heritage resources because the footprint for the new design is entirely contained within the footprint of the original design, and the entirety of this area was previously considered and assessed. All Archaeological Impact Assessment and Systematic Data Recovery (SDR) required has been completed to Project and Heritage Conservation Act Permit standards.

4. GOVERNMENT APPROVALS/ENDORSEMENTS

BC Hydro has submitted applications for the following permits and approvals related to the Highway 29 realignment at Farrell Creek:

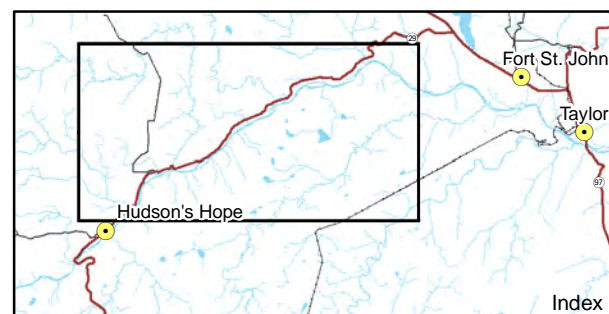
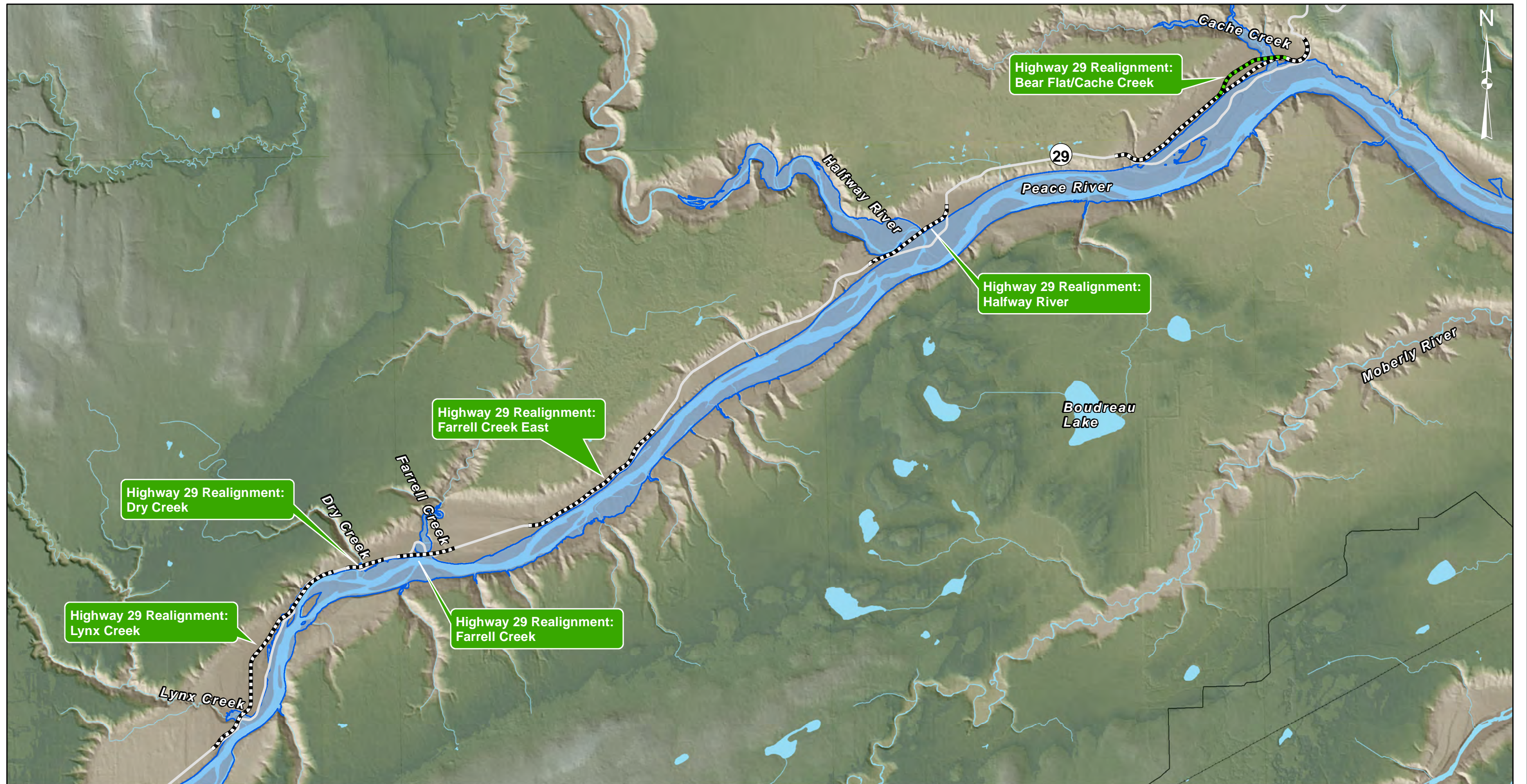
- *Land Act* Licence of Occupation (application submitted November 8, 2019)
- *Forest Act* Occupant Licence to Cut #20 (permit issued November 15, 2019)
- *Water Sustainability Act* Section 11 Approval for instream works (application submitted November 12, 2019)
- *Canadian Navigable Waters Act* Approval or Notice of Work (application submitted November 8, 2019)

⁵ <https://projects.eao.gov.bc.ca/api/document/58868f2fe036fb0105767ecf/fetch>

In addition, an assessment by a Qualified Environmental Professional of potential impacts to fish and fish habitat will be undertaken in accordance with the federal *Fisheries Act*.





5. ATTACHMENT - FIGURES

- Figure 1: Location of Highway 29 realignment segments, including Farrell Creek
- Figure 2: General arrangement of Highway 29 realignment segment at Farrell Creek, per EAC Schedule A (Figure 4.30 Rev 0)
- Figure 3: General arrangement of Highway 29 realignment segment at Farrell Creek, per proposed modified design (proposed Figure 4.30 Rev 1).
- Figure 4: Profile of Farrell Creek Bridge, per EAC Schedule A Design (not to scale)
- Figure 5: Profile of Farrell Creek Bridge, per proposed modified design (not to scale)
- Figure 6: Farrell Creek Bridge - EAC Schedule A Design versus Modified Design



Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LIDAR data acquired July/August, 2006.
 5. Highway design in progress and subject to change.

Legend

-  Proposed Highway 29 Realignment
-  Approved Highway 29 Realignment
-  Highway 29
-  Proposed Reservoir

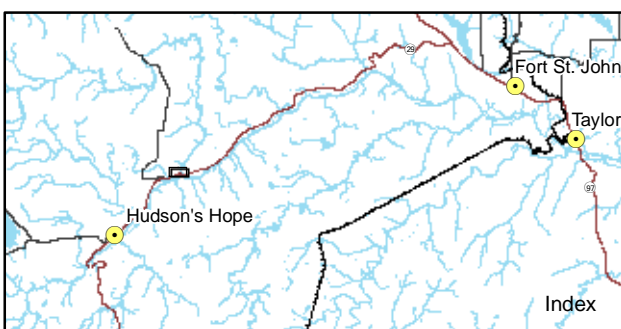
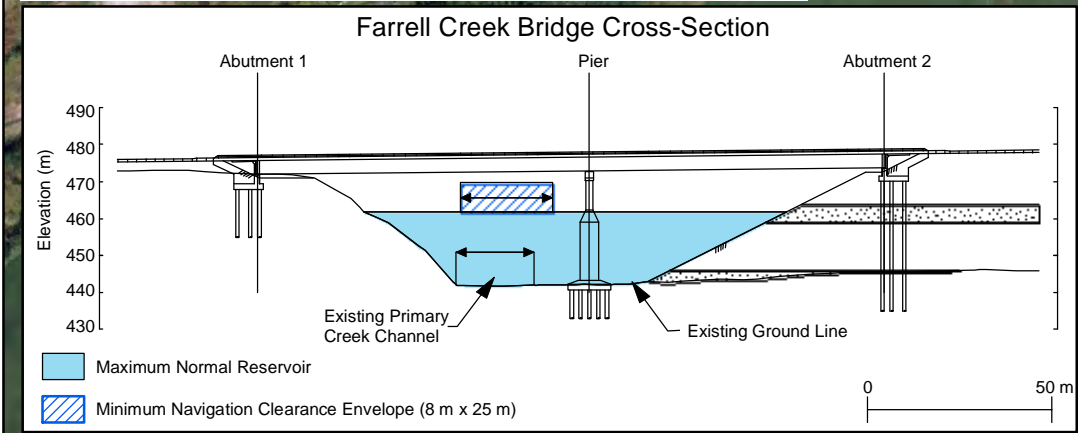
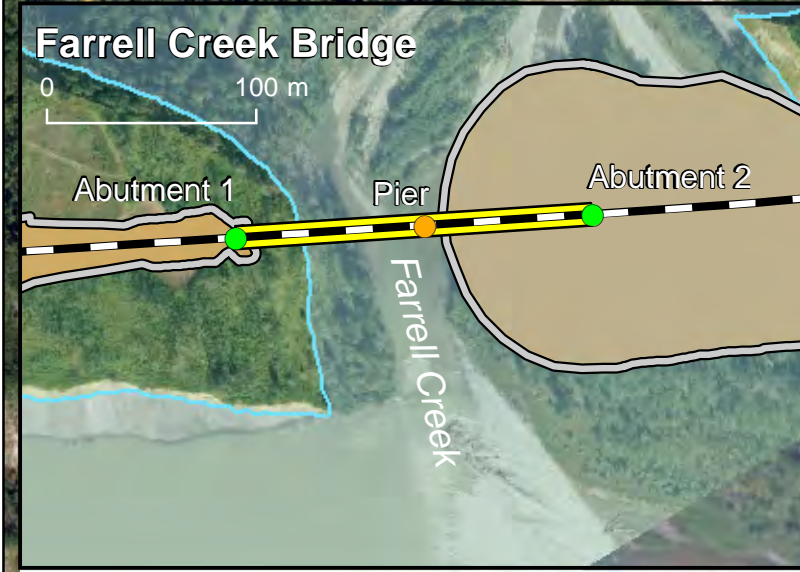
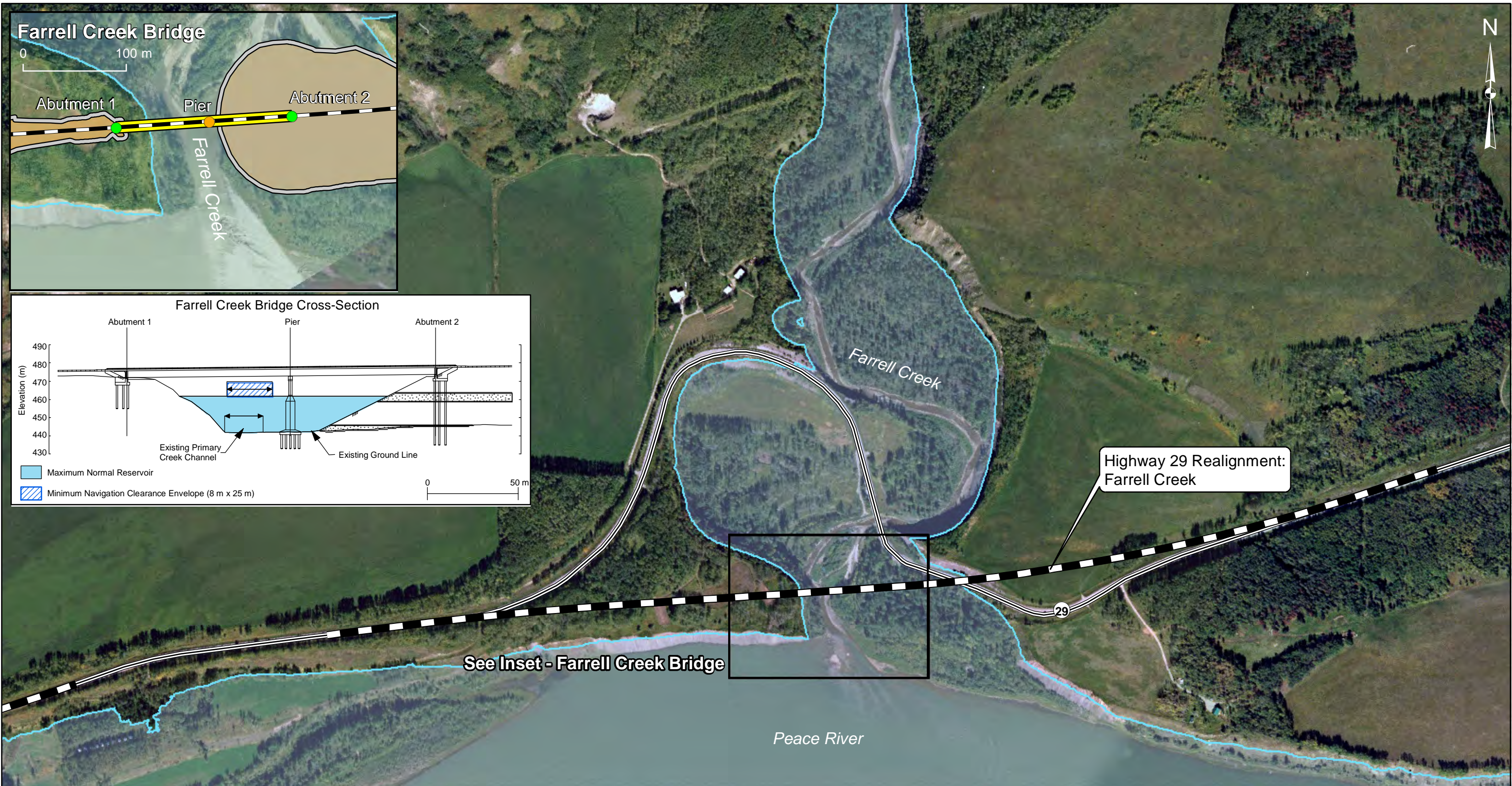
1:134,000 0 1.5 3 6 km



Figure 1: Location of Highway 29 realignment segments

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Construction of the Site C Clean Energy Project is subject to required regulatory and permitting approvals.



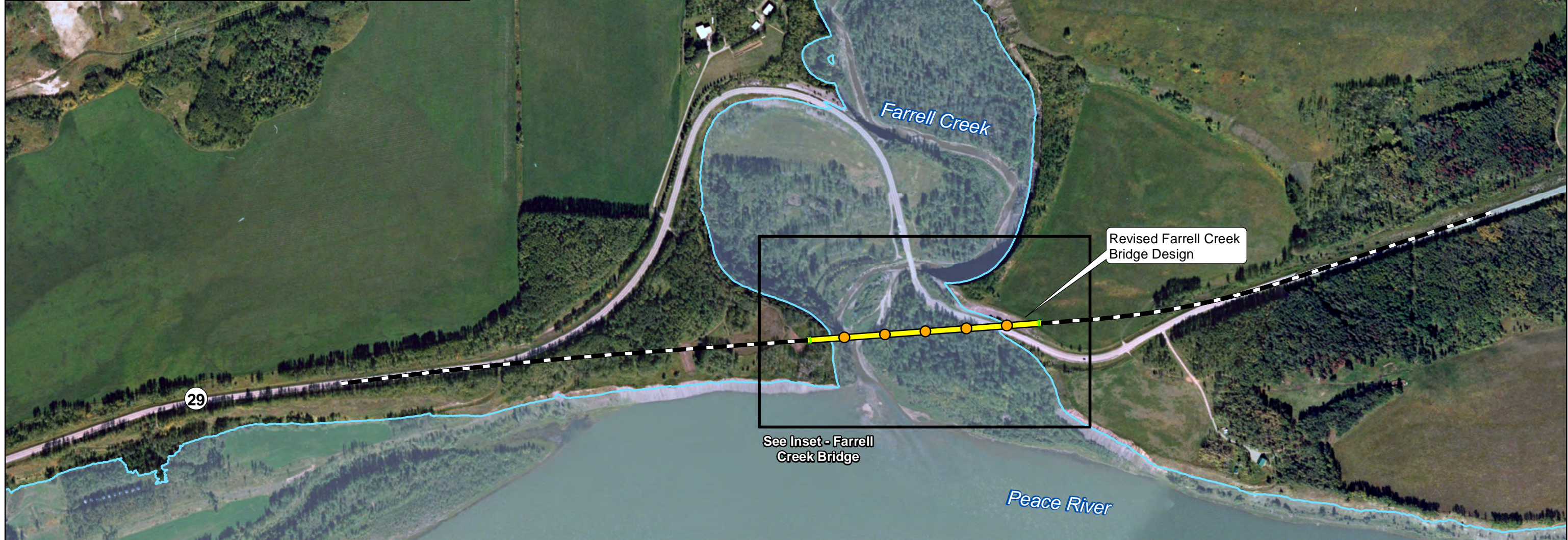
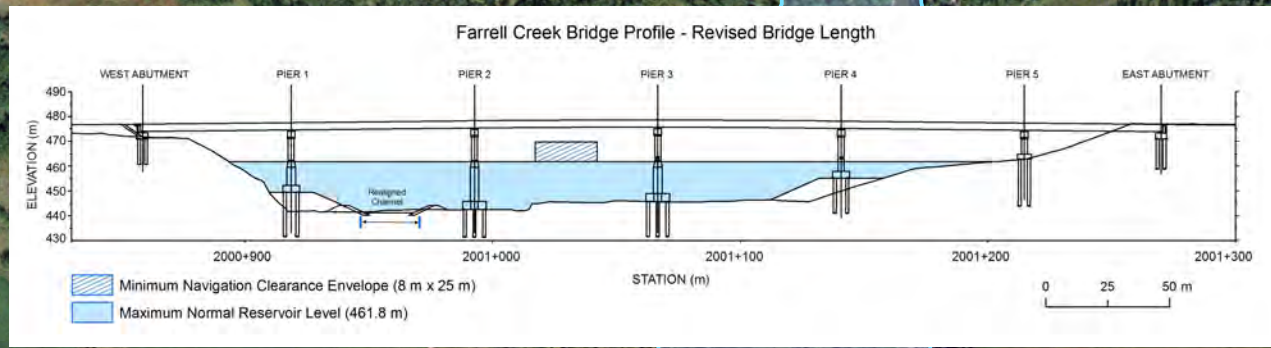
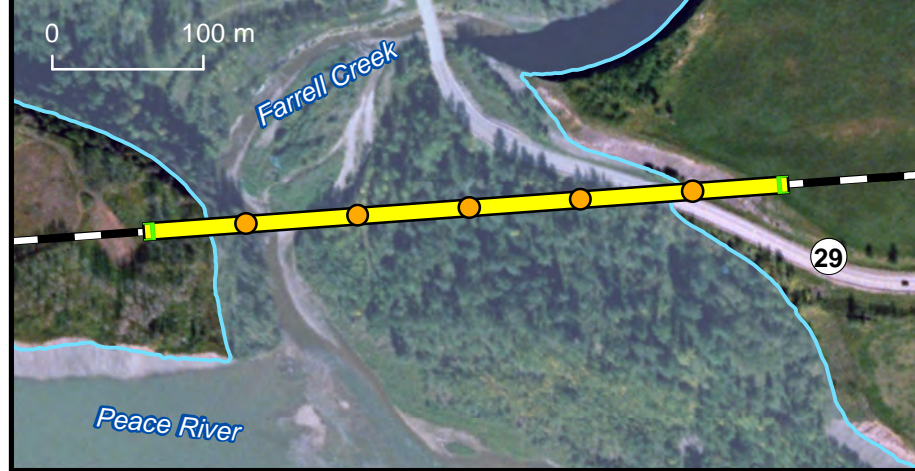
Map Notes:
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 2. Projection: UTM Zone 10N
 3. Orthophotos created from 1:40,000 photos taken Sept 10th 2007; 1:15,000 photos taken Aug 26, 2011; 1:5,000 photos taken Aug 26, 2011; TRIM
 4. Proposed maximum normal reservoir level (full supply level-461.8 m) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/Aug 2006.
 5. Realignments subject to change.
 6. Reservoir elevation = 461.8 m does not consider realignments.

- Legend**
- Highway 29 Realignment
 - Proposed Bridge
 - Road Embankment
 - Pier
 - Abutment
 - Maximum Normal Reservoir Level (461.8 m)
 - Existing Highway 29

1:7,000 0 0.25 km

Figure 4.30 General arrangement of Highway 29 realignment segment at Farrell Creek			
Date	Nov. 23, 2012	DWG NO	1016-C14-B6158-16 R 0

Farrell Creek Bridge



Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Orthophotos created from 1:40,000 photos taken Sept 10th 2007;
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August, 2006.
 6. Reservoir elevation 461.8 m does not consider realignment.

Legend

- Highway 29 Realignment
- Revised Farrell Creek Bridge Design
- Pier
- Abutment
- Maximum Normal Reservoir Level (461.8 m)

1:7,000 0 150 300 m



Figure 3: General arrangement of Highway 29 realignment segment at Farrell Creek, per proposed revised bridge design (proposed Figure 4.30 Rev 1)

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Construction of the Site C Clean Energy Project is subject to required regulatory and permitting approvals.

Figure 4: Profile of Farrell Creek Bridge, per EAC Schedule A Design (not to scale)

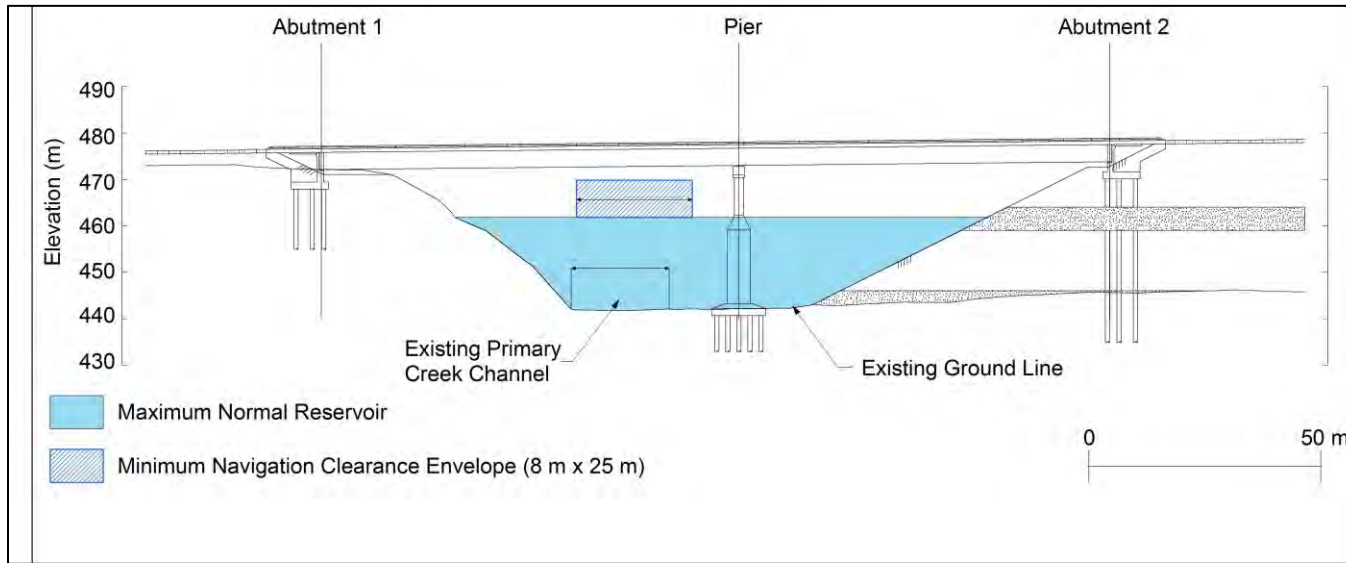
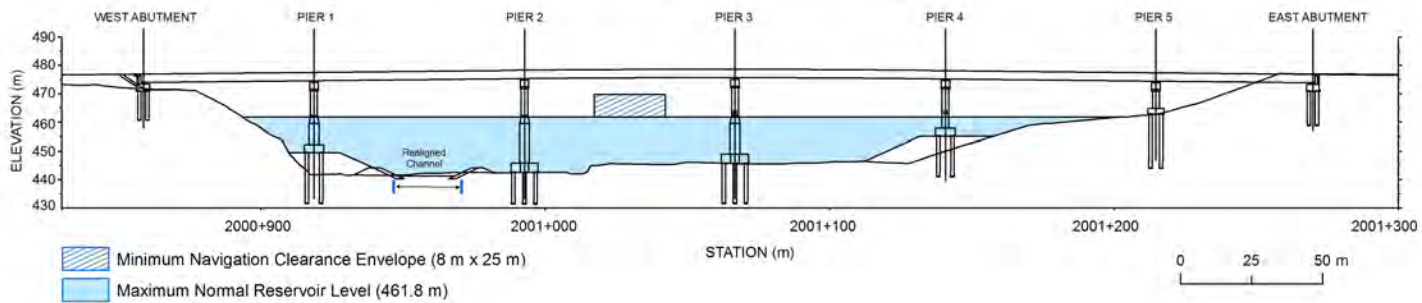


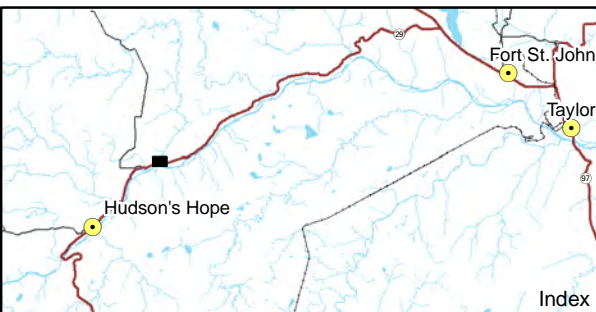
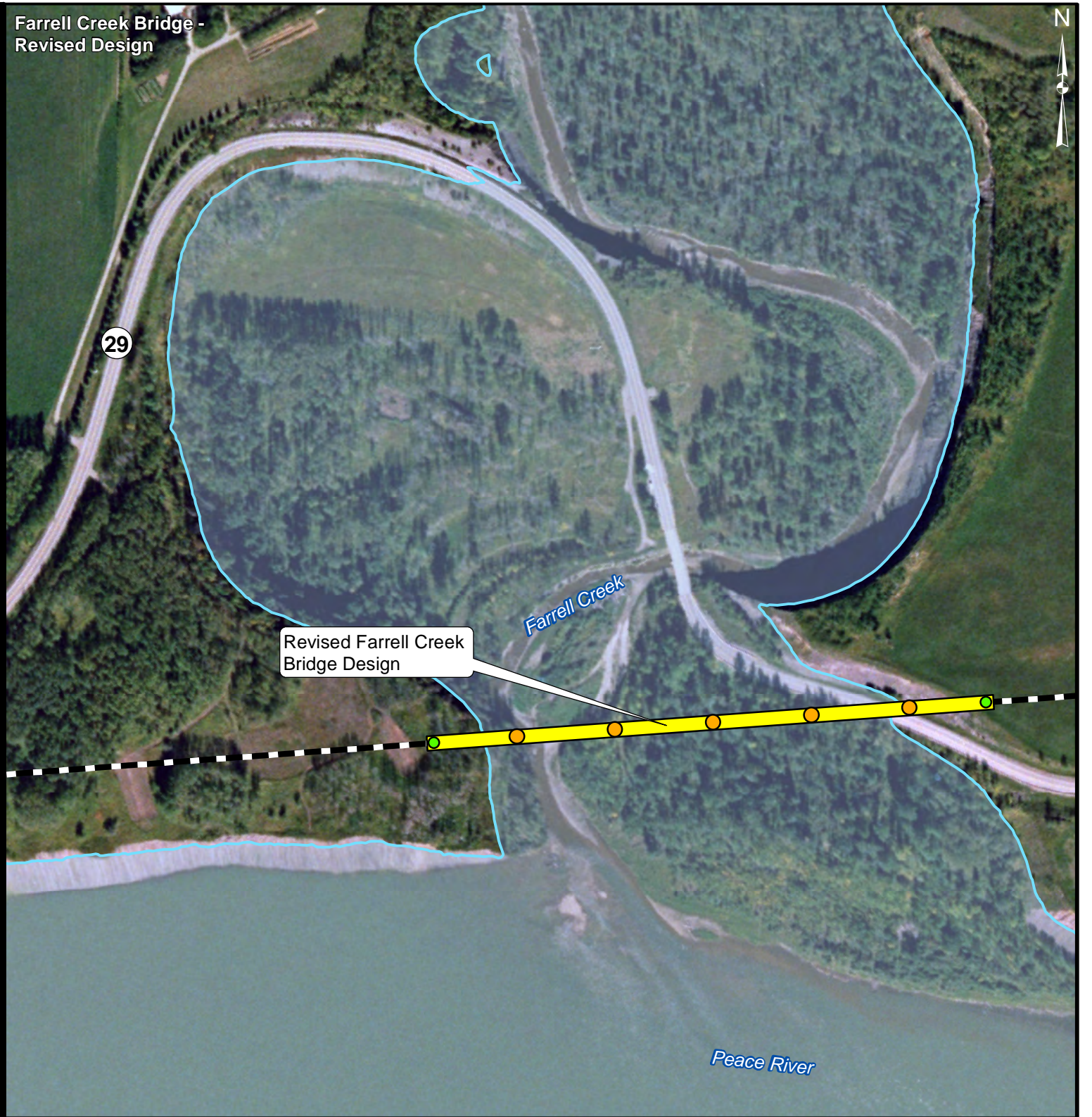
Figure 5: Profile of Farrell Creek Bridge, per proposed revised design (not to scale)



Farrell Creek Bridge -
EAC Schedule A Design



Farrell Creek Bridge -
Revised Design



Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Orthophotos created from 1:40,000 photos taken Sept 10th 2007
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LIDAR data acquired July/August, 2006.

- Legend**
- Highway 29 Realignment
 - EAC Farrell Creek Bridge
 - Revised Farrell Creek Bridge Design
 - Pier
 - Abutment
 - Causeway
 - Maximum Normal Reservoir Level (461.8 m)



BC Hydro

**Figure 6: Farrell Creek Bridge -
EAC Schedule A Design vs Revised Design**

Date	Dec 17, 2019	DWG NO	1016-N11-00669	R 0
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Appendix B
Supporting Information for Proposed Schedule A Revisions
Dry Creek Crossing

1. PROPOSED AMENDMENTS TO EAC SCHEDULE A, TABLE 4.5

The location of the Highway 29 crossing at Dry Creek is shown on Appendix B, Figure 1.

For the Highway 29 crossing at Dry Creek, BC Hydro is proposing to replace the EAC approved culvert with a bridge that will be up to 200m long. BC Hydro is therefore requesting the following revisions to EAC Schedule A, Section 4.3.4.1, Table 4.5:

Component	Text from EAC Schedule A Project Description	Requested Amendments to Schedule A Project Description
Highway 29 Realignment Dry Creek	Section 4.3.4.1, Table 4.5: Highway 29 Realignment Segments and Respective Watercourse Crossing Lengths For Dry Creek: Total Length of Segment: 1.5 km Causeway Length: N/A* Bridge Length: 11 m pipe-arch culvert Number of Piers: N/A Number of Bridge Spans: N/A Figure Number: Figure 4.29 Rev 0 (attached as Appendix B, Figure 2)	Section 4.3.4.1, Table 4.5: Highway 29 Realignment Segments and Respective Watercourse Crossing Lengths For Dry Creek: Total Length of Segment: 1.5 km Causeway Length: 0 m Bridge Length: up to 200 m Number of Piers: up to 3 Number of Bridge Spans: up to 4 Figure Number: Figure 4.29 Rev 1 (attached as Appendix B, Figure 3)

The Dry Creek crossing, as described in the EAC, consisted of a large culvert and embankment fill to cross the approximately 200m wide Dry Creek valley. In order to complete these works, a temporary diversion of Dry Creek would have been required and likely would have consisted of a temporary culvert to divert creek flows during the installation of the permanent culvert. This creek temporary diversion structure would have been constructed entirely within the area of disturbance assessed for the EAC.

The proposed revised crossing alignment is located at its widest point approximately 85m to the north of the EAC alignment. Much of the proposed revised crossing location is within the area of disturbance assessed for the EAC. However, as described below, temporary containment berms will be required to isolate Dry Creek from the bridge pier footing sites. These containment berms will extend north of the area of disturbance as assessed in the EAC, and have been considered in the evaluation of impacts of the proposed revised design on valued components.

2. DRY CREEK BRIDGE CONSTRUCTION

Typical bridge construction practices, including the use of temporary laydown areas off the ends of the bridge, may be developed by the contractor to facilitate highway and bridge construction. Material required for highway embankments will be sourced locally from areas that will be inundated by the future reservoir and, potentially, from future areas that will not be inundated by the future reservoir. A concrete batch plant may be setup to produce concrete for the Dry Creek Bridge. Steel piles and girders required in the bridge construction will be manufactured at, and delivered from, off-site facilities. Early in the construction of the Dry Creek Bridge, approximately 250m of the existing Dry Creek channel will be bermed to contain the creek to a defined channel, to facilitate construction of granular berms at the base of the west and east slopes of the Dry Creek valley. These containment berms will be in-place until

reservoir filling, currently scheduled for September 2023. Although not anticipated at this time, temporary diversion of Dry Creek may be required as the design and construction process is refined.

3. IMPACT TO VALUED COMPONENTS

The differences between the proposed revised design and the approved design in EAC Schedule A are not anticipated to cause any adverse effects on valued components beyond the effects that were considered and approved during the environmental assessment of the Project. For this assessment, the following valued components were reviewed and are described below: fish and fish habitat, vegetation and ecological communities, wildlife resources, harvest of fish and wildlife resources, current use of lands and resources for traditional purposes, navigation, and heritage resources. The following valued components were not assessed as they were determined to not interact either with the Highway 29 realignment or with the proposed revised design change to the Dry Creek crossing: greenhouse gases, local government revenue, labour market, regional economic development, agriculture, forestry, oil, gas and energy, outdoor recreation and tourism, visual resources, population and demographics, housing, community infrastructure and services, transportation, and human health.

The assessment is supported by information in Figures 4 and 5 – the EAC Culvert and Revised Design Bridge profiles -- and Figure 6, a plan view of the EAC Schedule A culvert design versus the proposed revised bridge design, post reservoir filling.

Fish and Fish Habitat

The effects of the Project on fish and fish habitat were assessed in the environmental assessment by considering changes to fish habitat, fish health and survival, and fish movement. Fish habitat and fish use data for Dry Creek are limited. Based on historical aerial photographs, Dry Creek remains disconnected from the mainstem of the Peace River except under freshet conditions. The existing Dry Creek culvert crossing at Highway 29 is a 1,800-mm diameter corrugated steel pipe with a perched outlet that impedes upstream fish passage. Additionally, approximately 150 linear metres of Dry Creek immediately upstream from its confluence with the Peace River is typically dewatered during low flow period, with apparent subsurface flows within the alluvial fan. This dewatering and presence of the impassible culvert currently precludes fish access and use of Dry Creek for Peace River fish populations. As such, use of Dry Creek by Peace River fish populations is expected to be very low.

The proposed design changes to the Highway 29 realignment at Dry Creek are not anticipated to affect the conclusions of the environmental assessment regarding the effects of the Project on Fish and Fish Habitat. Both the EAC crossing and proposed revised crossing at Dry Creek are at a location that will be converted from stream to reservoir habitat following reservoir filling. The culvert (11m pipe-arch) and surrounding infill area in the EAC design would have encroached on a substantial portion of the present creek channel and blocked aerial input of food and nutrients from above the channel. The revised design includes a pier and diversion berm in the present channel, but the elimination of the culvert infill area will result in an overall reduced aquatic footprint.

The containment channel to be constructed for the revised design would have also been required for the EAC design. This channel will maintain downstream passage for migrating fish, and will have similar habitat functions as the existing creek channel. Once the future reservoir is created, the open water in the proposed revised bridge design will create better aquatic habitat conditions than the culvert.

Overall, the construction and post-construction conditions for fish and fish habitat are expected to improve as a result of the design changes.

A detailed assessment of the instream impacts of the piers per the final bridge design will be undertaken by a qualified environmental professional prior to construction of the bridge, in accordance with the federal *Fisheries Act*.

Vegetation and Ecological Communities and Wildlife Resources

The effects of the Highway 29 realignment on vegetation and ecological communities were assessed as part of the assessment of the effects of the Project on vegetation and ecological communities. That assessment focused on the key indicators of terrestrial ecosystems and rare plants. The effects of the Project on terrestrial ecosystems and rare plants were determined in the EIS to be significant due to Project impacts on rare ecological communities and rare plants.

The effects of the Highway 29 realignment on wildlife resources were assessed as part of the effects of the Project on wildlife resources. That assessment focused on a number of wildlife key indicators under the species groups of butterflies and dragonflies, amphibians and reptiles, migratory birds, non-migratory game birds, raptors, bats, fur-bearers, ungulates, and large carnivores. The effects of the Project on wildlife resources were determined to be significant due to the alteration and fragmentation of habitat for avian species of provincial and federal conservation concern.

The proposed revision to the design of the Dry Creek crossing is not expected to cause any additional effects on vegetation and ecological communities or wildlife resources beyond those predicted in the EIS. As shown in Figures 6, the culvert and associated infill per the EAC Schedule A design will be replaced by bridge up to 200m long, resulting in a small decrease in the terrestrial footprint of the Dry Creek crossing.

The revised bridge design is expected to increase disturbance to the blue-listed Fm02 – Balsam poplar – White spruce/Mountain alder – red-osier dogwood ecological community by approximately 0.8 ha. As the effects of the Project on this ecological community were predicted in the EIS to be high magnitude, the 0.8 ha increase in disturbance to this community due to the revised design does not change the conclusions of the EIS regarding vegetation and ecological communities.

As the revised design results in an overall decrease in the terrestrial footprint of the Dry Creek crossing, it also does not change the conclusions of the EIS regarding wildlife resources.

Harvest of Fish and Wildlife Resources

Project effects on the harvest of fish and wildlife resources were assessed in the EIS by considering Project changes to the use of and access to hunting, fishing, trapping, and guide outfitter areas, tenure areas, or the availability of harvested species based on the results of the assessment of the Project on fish and wildlife resources. Because the proposed revised design of the Dry Creek Bridge will not result in any additional effects on fish and fish habitat, vegetation and ecological communities, and wildlife resources, it is not expected to cause any additional effects on the harvest of fish and wildlife resources beyond those predicted in the EIS.

Current Use of Lands and Resources for Traditional Purposes

Project effects on current use of lands and resources for traditional purposes were assessed in the EIS by considering Project changes to current use of lands and resources for hunting, fishing and trapping activities, as well as current use of lands and resources for activities other than hunting, fishing and trapping by Indigenous groups, including cultural activities. The revised design of the Dry Creek crossing will result in reduced interactions with fish and fish habitat, and will not result in any additional effects on vegetation and ecological communities or wildlife resources. In addition, the revised design is not expected to result in any additional effects on activities other than hunting, fishing or trapping by Indigenous groups, including cultural activities. Therefore, the revised design is not expected to cause any additional effects on the current use of lands and resources beyond those predicted in the EIS.

Navigation

The proposed revision to the Dry Creek crossing design is not expected to result in any additional effects on navigation beyond those predicted in the EIS. The Dry Creek crossing design in EAC Schedule A did not show a navigation envelope for vessels as the crossing was designed as a culvert. During the environmental assessment, Transport Canada provided an analysis that resulted in the recommendation that the Farrell, Lynx and Cache Creek Bridge designs contain a clearance envelope that is 8m high, as measured from the 461.8m reservoir elevation level, and 25m wide; however, Dry Creek was not assigned a minimum clearance envelope.⁶

The proposed revised bridge design would have a clearance envelope that is 3m high, 10m wide in accordance with a memo sent to Transport Canada regarding Highway 29 bridge crossings.⁷ Based on the water depths and minimal wetted area upstream of this crossing as well as the navigation clearance envelope, the proposed revisions at the Dry Creek Highway 29 crossing is not expected to result in reductions in boater access or navigation.

Navigation channel marks and boater notifications for the revised bridge would meet all requirements for compliance under the *Canadian Navigable Waters Act*.

Heritage Resources

A comprehensive Effects Assessment for Heritage Resources was undertaken for the EIS (see EIS Volume 4 Appendix C, Technical Appendix: Heritage Resource Assessment Report). Information and data for the Effects Assessment was drawn from 1) literature reviews, including palaeontological resources, archaeological resources, and historical resources, 2) consultation between BC Hydro and Indigenous groups, and 3) an extensive, multi-year field inventory and survey.

The proposed revision to the Dry Creek crossing design is not expected to cause any additional effects on heritage resources because the footprints of the original and the new designs are both entirely contained within the area previously considered and assessed for heritage resources. There are no known archaeology sites in conflict with the bridge footprint. All Archaeological Impact Assessment and

⁶ <https://projects.eao.gov.bc.ca/api/document/58868f2fe036fb0105767ecf/fetch>

⁷ Memo to Transport Canada from Siobhan Jackson (BCH), RE: Site Clean Energy Project: Navigation Clearances for Highway 29 Bridge Crossings. 11 October, 2011.

Systematic Data Recovery (SDR) required for the Dry Creek highway segment has been completed to Project and Heritage Conservation Act Permit standards.

4. GOVERNMENT APPROVALS/ENDORSEMENTS

BC Hydro will be submitting applications for the following permits and approvals related to the Highway 29 realignment at Dry Creek:

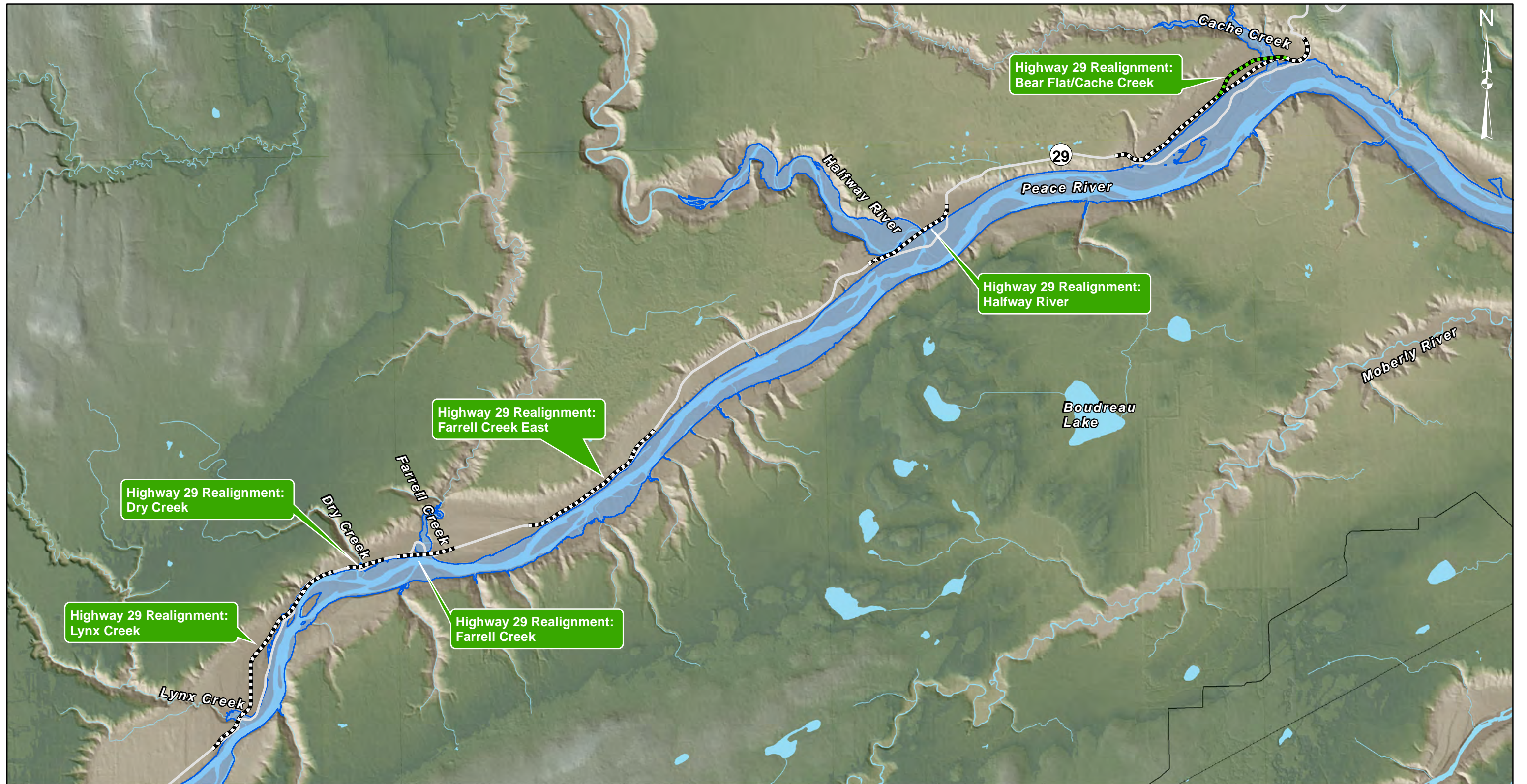
- *Land Act* Licence of Occupation (planned application date December 2019)
- *Forest Act* Occupant Licence to Cut (issued November 15, 2019)
- *Water Sustainability Act* Section 11 Approval for instream works (application submitted November 29, 2019)
- *Water Sustainability Act* Section 10 Approval for Short Term Use (planned application date December 2019)
- *Canadian Navigable Waters Act* Approval or Notice of Work (application submitted November 29, 2019)

In addition, an assessment by a Qualified Environmental Professional of potential impacts to fish and fish habitat will be undertaken in accordance with the federal *Fisheries Act*.

5. ATTACHMENTS





Appendix A: Figures

- Figure 1: Location of Highway 29 realignment segments, including Dry Creek
- Figure 2: General arrangement of Highway 29 realignment segment at Dry Creek, per EAC Schedule A (Figure 4.29 Rev 0)
- Figure 3: General arrangement of Highway 29 realignment segment at Dry Creek, per proposed revised design (proposed Figure 4.29 Rev 1).
- Figure 4: Profile of Dry Creek Culvert, per EAC Schedule A Design (not to scale)
- Figure 5: Profile of Dry Creek Bridge, per proposed revised design (not to scale)
- Figure 6: Dry Creek Bridge - EAC Schedule A Design versus Revised Design



Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LIDAR data acquired July/August, 2006.
 5. Highway design in progress and subject to change.

Legend

-  Proposed Highway 29 Realignment
-  Approved Highway 29 Realignment
-  Highway 29
-  Proposed Reservoir

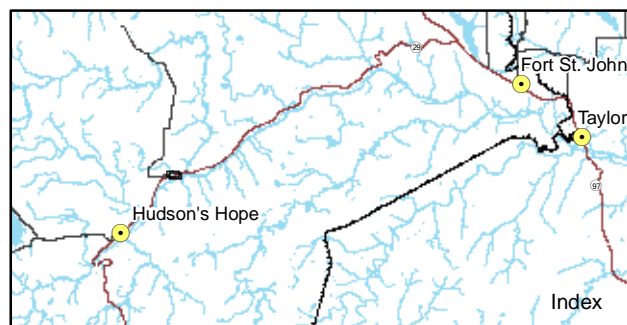
1:134,000 0 1.5 3 6 km



Figure 1: Location of Highway 29 realignment segments




Date	Dec 9, 2019	DWG NO	1016-N11-00712	R 0
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Construction of the Site C Clean Energy Project is subject to required regulatory and permitting approvals.





Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Orthophotos created from 1:40,000 photos taken Sept 10th 2007; 1:15,000 photos taken Aug 26, 2011; 1:5,000 photos taken Aug 26, 2011; TRIM
 4. Proposed maximum normal reservoir level (full supply level-461.8 m) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/Aug 2006.
 5. Realignments subject to change.
 6. Reservoir elevation = 461.8 m does not consider realignments.

Legend

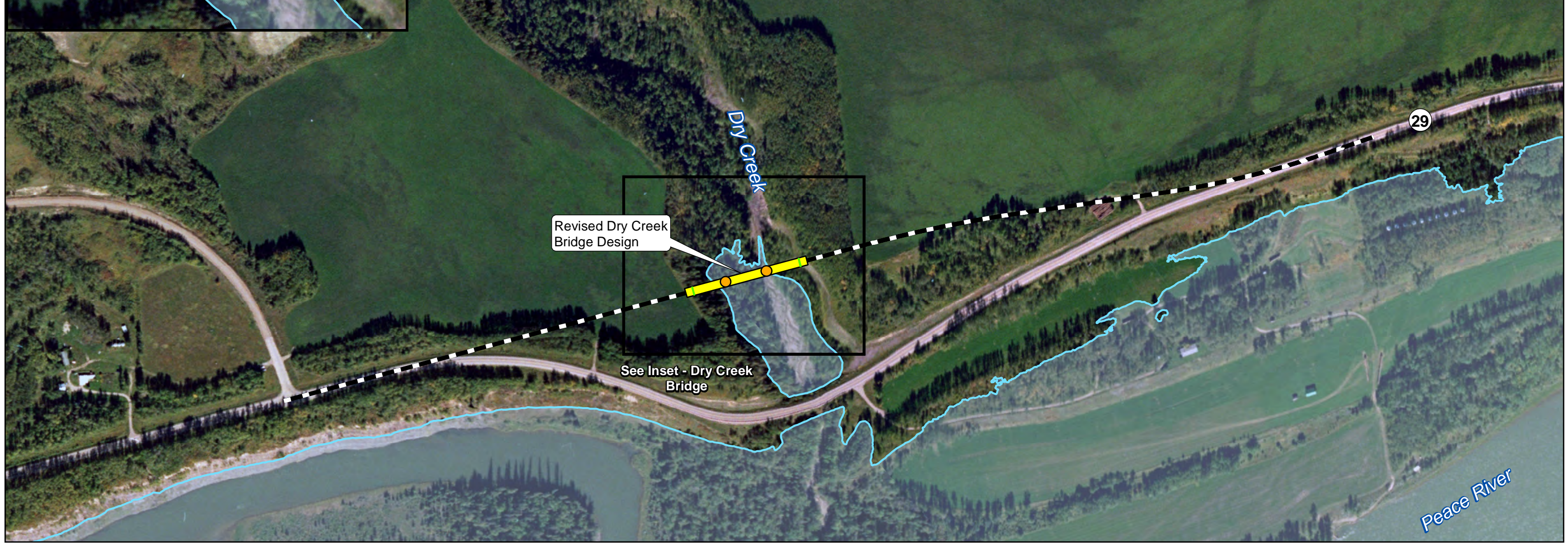
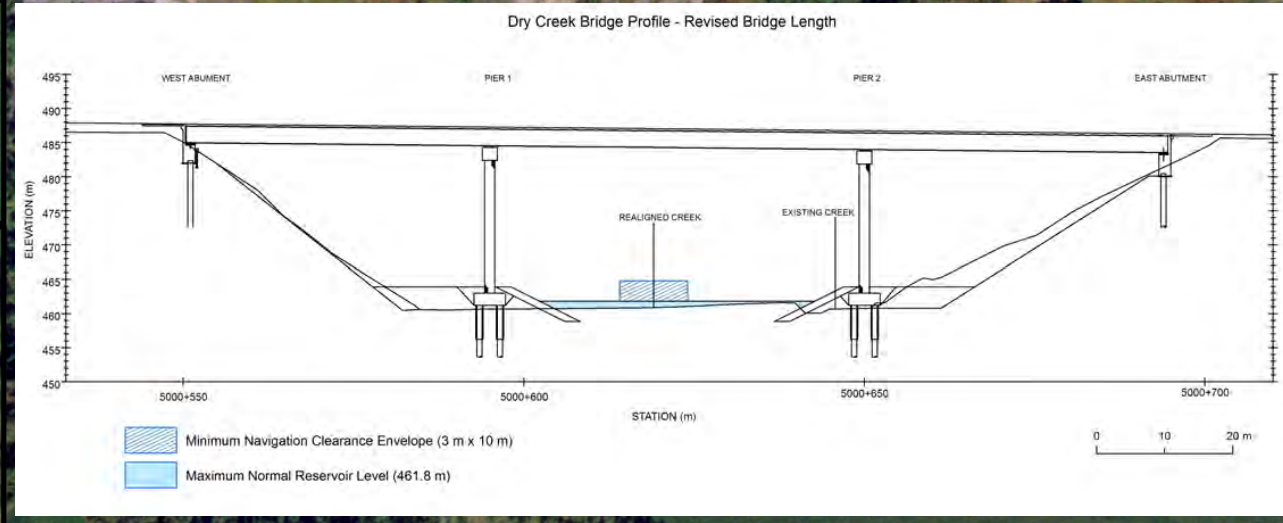
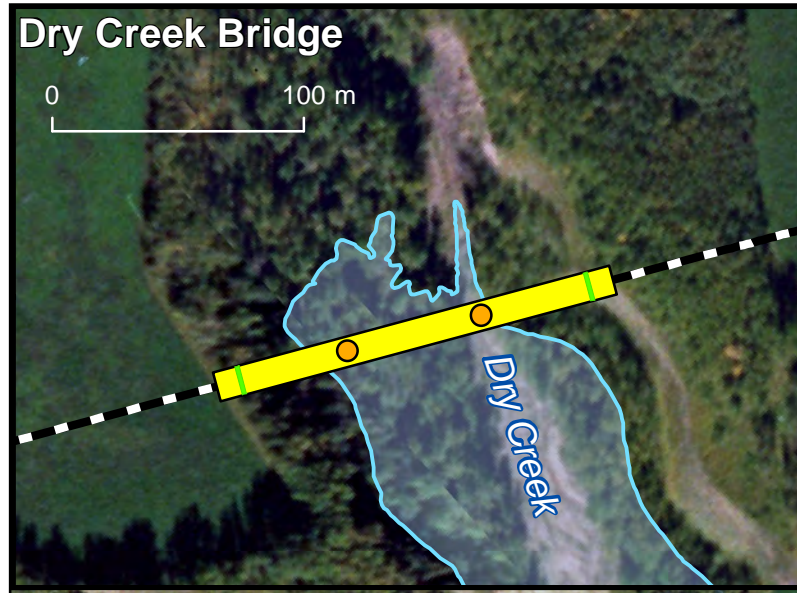
-  Highway 29 Realignment
-  Pipe Arch
-  Maximum Normal Reservoir Level (461.8 m)

1:5,000 0 0.25 km

				
		Figure 4.29 General arrangement of Highway 29 realignment segment at Dry Creek		
Date	Nov. 23, 2012	DWG NO	1016-C14-B6158-15	R 0

Dry Creek Bridge

0 100 m



Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Orthophotos created from 1:40,000 photos taken Sept 10th 2007;
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/August, 2006.
 6. Reservoir elevation 461.8 m does not consider realignment.

Legend

- Highway 29 Realignment
- Revised Dry Creek Bridge Design
- Pier
- Abutment
- Maximum Normal Reservoir Level (461.8 m)

1:5,000 0 100 200 m



Figure 3: General arrangement of Highway 29 realignment segment at Dry Creek, per proposed revised bridge design (proposed Figure 4.29 Rev 1)

Date	Dec 4, 2019	DWG NO	1016-C14-B6158-15	R 1
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Construction of the Site C Clean Energy Project is subject to required regulatory and permitting approvals.

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Figure 4: Profile of Dry Creek Crossing, per EAC Schedule A Design (not to scale)

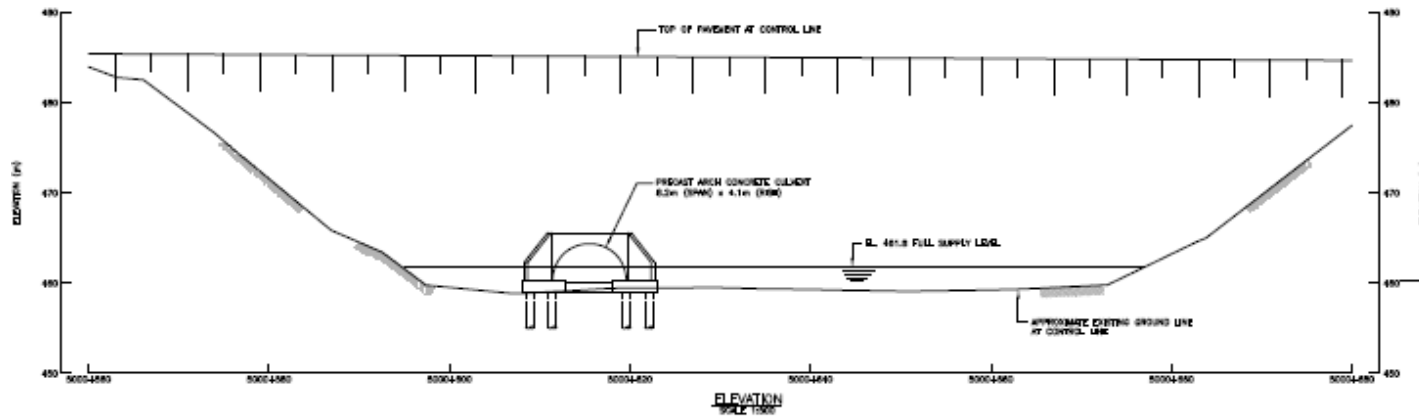
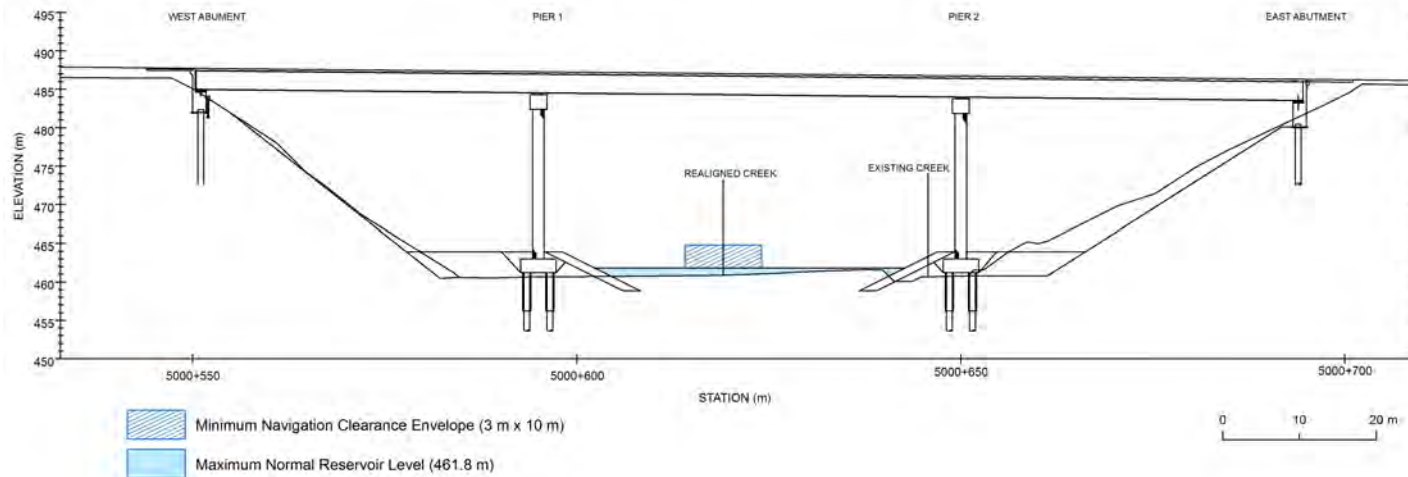
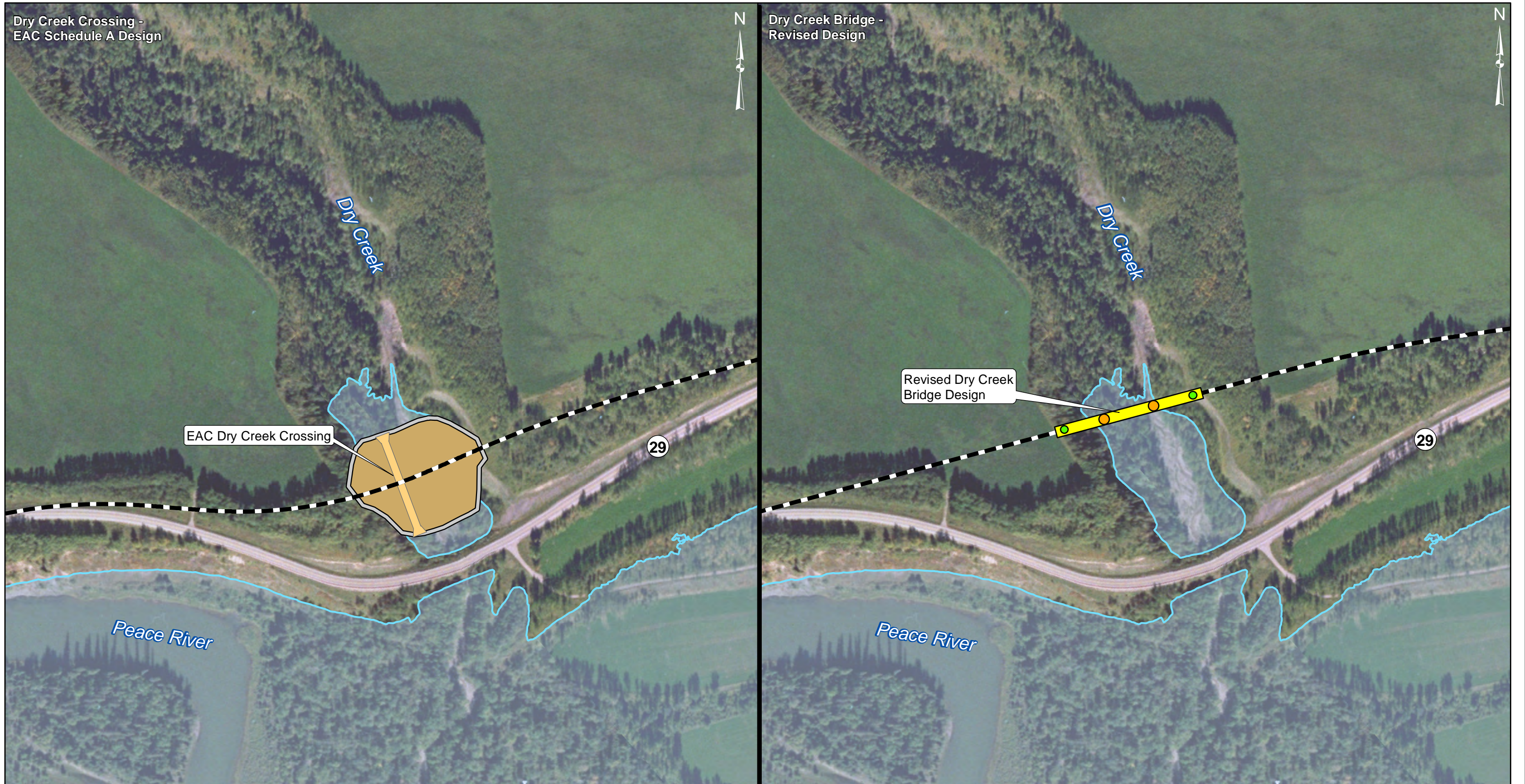


Figure 5: Profile of Dry Creek Crossing, per proposed revised design (not to scale)



Dry Creek Crossing -
EAC Schedule A Design

Dry Creek Bridge -
Revised Design



EAC Dry Creek Crossing

Revised Dry Creek
Bridge Design

29

29

Peace River

Peace River



Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Orthophotos created from 1:40,000 photos taken Sept 10th 2007
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LIDAR data acquired July/August, 2006.
 6. Reservoir elevation 461.8 m does not consider highway realignment.

- Legend**
- Highway 29 Realignment
 - Pipe Arch Culvert
 - Revised Dry Creek Bridge Design
 - Pier
 - Abutment
 - Culvert Infill
 - Maximum Normal Reservoir Level (461.8 m)

1:4,000 0 100 200 m



**Figure 6: Dry Creek Bridge -
EAC Schedule A Design vs Revised Design**

Date	Dec 10, 2019	DWG NO	1016-N11-00670	R 0
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Construction of the Site C Clean Energy Project is subject to required regulatory and permitting approvals.

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Appendix C
Supporting Information for Proposed Schedule A Revisions
Lynx Creek Crossing

1. PROPOSED AMENDMENTS TO EAC SCHEDULE A, TABLE 4.5

The location of the Highway 29 crossing at Lynx Creek is shown on Appendix B, Figure 1.

For the Highway 29 crossing at Lynx Creek, BC Hydro is proposing to modify the EAC approved causeway and bridge to a causeway and bridge that will be 30m and 20m longer respectively. BC Hydro is therefore requesting the following revisions to EAC Schedule A, Section 4.3.4.1, Table 4.5:

Component	Text from EAC Schedule A Project Description	Requested Amendments to Schedule A Project Description
Highway 29 Realignment Lynx Creek	Section 4.3.4.1, Table 4.5: Highway 29 Realignment Segments and Respective Watercourse Crossing Lengths For Lynx Creek: Total Length of Segment: 8.0 km Causeway Length: 290 m Bridge Length: 160 m Number of Piers: 1 Number of Bridge Spans: 2 Figure Number: Figure 4.28 Rev 0 (attached as Appendix C, Figure 2)	Section 4.3.4.1, Table 4.5: Highway 29 Realignment Segments and Respective Watercourse Crossing Lengths For Lynx Creek: Total Length of Segment: 8.0 km Causeway Length: up to 290 m Bridge Length: up to 180 m Number of Piers: up to 3 Number of Bridge Spans: up to 4 Figure Number: Figure 4.28 Rev 1 (attached as Appendix C, Figure 3)

As shown in Figures 2, 3 and 6, the proposed design changes to the Lynx Creek crossing will not materially change the alignment of the crossing, with the proposed revised alignment a few degrees offset from the EAC approved alignment. The height of the causeway for the proposed revised crossing has been lowered, resulting in a design requiring additional excavation within the vicinity of the crossing. This excavation will take place within the area of disturbance as assessed for the EAC. In addition, this excavation would be used in the causeway construction, thereby reducing the need to haul material from external sources for construction.

2. LYNX CREEK BRIDGE CONSTRUCTION

Typical bridge construction practices, including the use of temporary laydown areas off the ends of the bridge, may be developed by the contractor to facilitate highway and bridge construction. Material required for highway embankments will be sourced locally from areas that will be inundated by the future reservoir and, potentially, from future areas that will not be inundated by the future reservoir. A concrete batch plant may be setup to produce concrete for the Lynx Creek bridge. Steel piles and girders required in the bridge construction will be manufactured at, and delivered from, off-site facilities. Early in the construction of the Lynx Creek bridge, approximately 250 m of the existing Lynx Creek channel will be bermed and armored to contain the creek to a defined channel, and facilitate construction of granular berms at the base of the west and east slopes of the Lynx Creek valley. These containment berms will be in-place until reservoir filling, currently scheduled for September 2023. Although it is not anticipated at this time, should conditions change during the progression of design and through the course of construction, a temporary creek diversion may be required to facilitate the construction.

3. IMPACT TO VALUED COMPONENTS

The differences between the proposed revised design and the approved design in EAC Schedule A are not anticipated to cause any adverse effects on valued components beyond the effects that were considered and approved during the environmental assessment of the Project. For this assessment, the following valued components were reviewed and are described below: fish and fish habitat, vegetation and ecological communities, wildlife resources, harvest of fish and wildlife resources, current use of lands and resources for traditional purposes, navigation, and heritage resources. The following valued components were not assessed as they were determined to not interact either with the Highway 29 realignment or with the proposed revised design change to the Farrell Creek crossing: greenhouse gases, local government revenue, labour market, regional economic development, agriculture, forestry, oil, gas and energy, outdoor recreation and tourism, visual resources, population and demographics, housing, community infrastructure and services, transportation, and human health.

The assessment is supported by information in Figures 4 and 5 – the EAC and Revised Design bridge profiles -- and Figure 6, a plan view of the EAC Schedule A bridge design versus the proposed revised design, post reservoir filling.

Fish and Fish Habitat

The effects of the Project on fish and fish habitat were assessed in the environmental assessment by considering changes to fish habitat, fish health and survival, and fish movement. As described in the EIS, the section of Lynx Creek adjacent to the realignment provides rearing and feeding habitats for sucker and minnow species, and acts as a migration corridor for fish moving between the Peace River and spawning and rearing habitats further upstream. The EIS concluded that the construction of the Highway 29 realignment at Lynx Creek would not result in a potential loss of fish habitat. The EIS also concluded that the construction of Highway 29 realignments would not result in adverse residual effects on fish health and survival or fish movement if mitigation measures, such as erosion and sediment control, are implemented.

The proposed revision to the Lynx Creek Bridge design is not expected to cause any additional effects on fish and fish habitat beyond those predicted in the EIS. Both the EAC bridge design and the proposed revised design crossing at Lynx Creek at a location that will be converted from stream to reservoir habitat following reservoir filling. Both the causeway and bridge lengths for both the EAC design and the revised design are similar, with the bridge potentially being longer by 20 m. Both the EAC and revised crossing designs have piers located outside the present Lynx Creek channel.

For the revised design, the existing creek will be bermed and armoured to contain the creek to the channel. This armoring will isolate works around the piers from flowing water, and reduce risks to erosion and sediment control. A similar channel would have been required for construction for the EAC design. The proposed armoring of the channel will continue to allow fish passage to habitat upstream of the bridge crossing before the area is inundated by the future reservoir.

Final design details are pending for the proposed revised bridge. A detailed assessment of the instream impacts of the final bridge design will be undertaken by a qualified environmental professional prior to construction of the bridge, in accordance with the federal *Fisheries Act*.

Vegetation and Ecological Communities and Wildlife Resources

The effects of the Highway 29 realignment on vegetation and ecological communities were assessed as part of the assessment of the effects of the Project on vegetation and ecological communities. That assessment focused on the key indicators of terrestrial ecosystems and rare plants. The effects of the Project on terrestrial ecosystems and rare plants were determined in the EIS to be significant due to Project impacts on rare ecological communities and rare plants.

The effects of the Highway 29 realignment on wildlife resources were assessed as part of the effects of the Project on wildlife resources. That assessment focused on a number of wildlife key indicators under the species groups of butterflies and dragonflies, amphibians and reptiles, migratory birds, non-migratory game birds, raptors, bats, fur-bearers, ungulates, and large carnivores. The effects of the Project on wildlife resources were determined to be significant due to the alteration and fragmentation of habitat for avian species of provincial and federal conservation concern.

The proposed revision to the Lynx Creek crossing design is not expected to cause any additional effects on vegetation and ecological communities or wildlife resources beyond those predicted in the EIS. Both the causeway and bridge lengths for both the EAC design and the revised design are similar, with the revised bridge potentially being longer by 20 m. The revised design is expected to result in less disturbance to terrestrial habitat than the EAC design. Therefore, no additional impact on sensitive ecological communities or wildlife habitat is anticipated beyond what has been assessed in the EIS.

Harvest of Fish and Wildlife Resources

Project effects on the harvest of fish and wildlife resources were assessed in the EIS by considering Project changes to the use of and access to hunting, fishing, trapping, and guide outfitter areas, tenure areas, or the availability of harvested species based on the results of the assessment of the Project on fish and wildlife resources. Because the proposed revised design of the Lynx Creek Bridge will not result in any additional effects on fish and fish habitat, vegetation and ecological communities, and wildlife resources, it is not expected to cause any additional effects on the harvest of fish and wildlife resources beyond those predicted in the EIS.

Current Use of Lands and Resources for Traditional Purposes

Project effects on Current Use of Lands and Resources for Traditional Purposes were assessed in the EIS by considering Project changes to current use of lands and resources for hunting, fishing and trapping activities, as well as current use of lands and resources for activities other than hunting, fishing and trapping by Indigenous groups, including cultural activities. The revised design of the Lynx Creek Bridge will result in reduced interactions with fish and fish habitat, and will not result in any additional effects on vegetation and ecological communities or wildlife resources. In addition, the revised design is not expected to result in any additional effects on activities other than hunting, fishing or trapping by Indigenous groups, including cultural activities. Therefore, the revised design is not expected to cause any additional effects on the current use of lands and resources beyond those predicted in the EIS.

Navigation

The proposed modification to the Lynx Creek Bridge design is not expected to result in any additional effects on navigation beyond those predicted in the EIS. The Lynx Creek Bridge design in EAC Schedule A

includes a pier and a minimum navigation clearance envelope equal to 8m high (as measured from maximum normal reservoir elevation, 461.8m), and 25m wide. During the environmental assessment, Transport Canada provided an analysis that resulted in the recommendation that the Lynx Creek Bridge design contain a clearance envelope that is 8m high, as measured from the 461.8m reservoir elevation level, and 25m wide.⁸ The proposed revised bridge design meets these requirements.

Navigation channel marks and boater notifications for the revised bridge would meet all requirements for compliance under the *Canadian Navigable Waters Act*. Boater access during the construction phase was described in the EIS, including the Lynx Creek boat launch. No restrictions to boater access are expected to result from the changes to the design.

Heritage Resources

A comprehensive Effects Assessment for Heritage Resources was undertaken for the EIS (see EIS Volume 4 Appendix C, Technical Appendix: Heritage Resource Assessment Report). Information and data for the Effects Assessment was drawn from 1) literature reviews, including palaeontological resources, archaeological resources, and historical resources, 2) consultation between BC Hydro and Indigenous groups, and 3) an extensive, multi-year field inventory and survey.

The proposed modification to the Lynx Creek Bridge design is not expected to cause any additional effects on heritage resources because the footprints of the original and the new designs are both entirely contained within the area previously considered and assessed for heritage resources. There are no known archaeology sites in conflict with the bridge footprint. All Archaeological Impact Assessment and Systematic Data Recovery (SDR) required for the Lynx Creek highway segment has been completed to Project and Heritage Conservation Act Permit standards.

4. GOVERNMENT APPROVALS/ENDORSEMENTS

BC Hydro will be submitting applications for the following permits and approvals related to the Highway 29 realignment at Lynx Creek:

- *Land Act* Licence of Occupation (planned application date December 2019)
- *Forest Act* Occupant Licence to Cut (planned application date December 2019)
- *Water Sustainability Act* Section 11 Approval for instream works (planned application date December 2019)
- *Water Sustainability Act* Section 10 Approval Short Term Use (planned application date December 2019)
- *Canadian Navigable Waters Act* Approval or Notice of Work (planned application date December 2019)

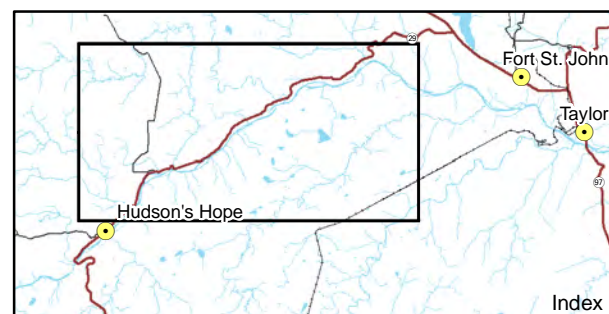
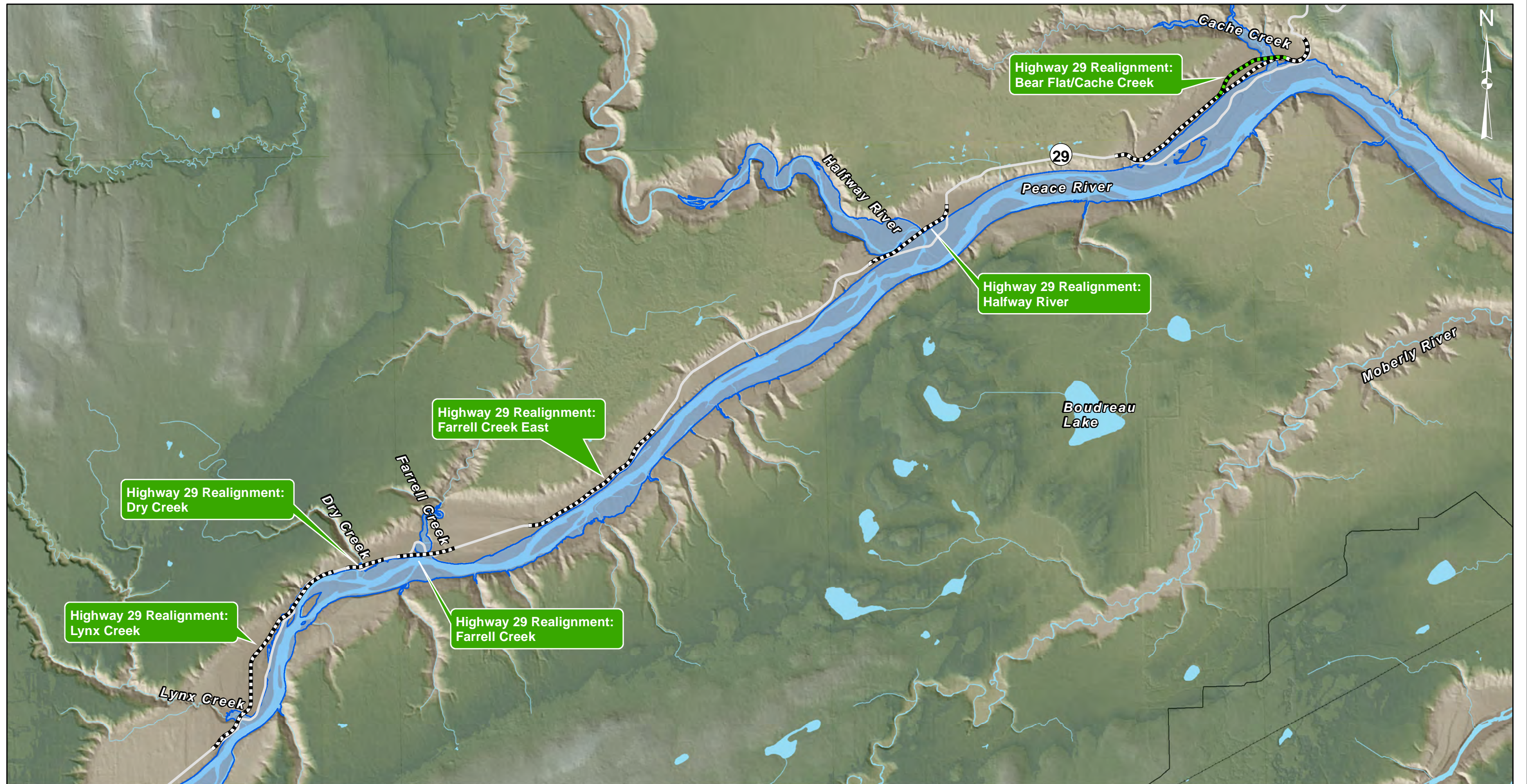
In addition, an assessment by a Qualified Environmental Professional of potential impacts to fish and fish habitat will be undertaken in accordance with the federal *Fisheries Act*.

⁸ <https://projects.eao.gov.bc.ca/api/document/58868f2fe036fb0105767ecf/fetch>

5. ATTACHMENTS





Appendix A: Figures

- Figure 1: Location of Lynx Creek Highway 29 realignment segment
- Figure 2: General arrangement of Highway 29 realignment segment at Lynx Creek, per EAC Schedule A (Figure 4.28 Rev 0)
- Figure 3: General arrangement of Highway 29 realignment segment at Lynx Creek, per proposed revised design (proposed Figure 4.28 Rev 1).
- Figure 4: Profile of Lynx Creek Bridge, per EAC Schedule A Design (not to scale)
- Figure 5: Profile of Lynx Creek Bridge, per proposed revised design (not to scale)
- Figure 6: Lynx Creek Bridge - EAC Schedule A Design versus Revised Design



Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LIDAR data acquired July/August, 2006.
 5. Highway design in progress and subject to change.

Legend

-  Proposed Highway 29 Realignment
-  Approved Highway 29 Realignment
-  Highway 29
-  Proposed Reservoir

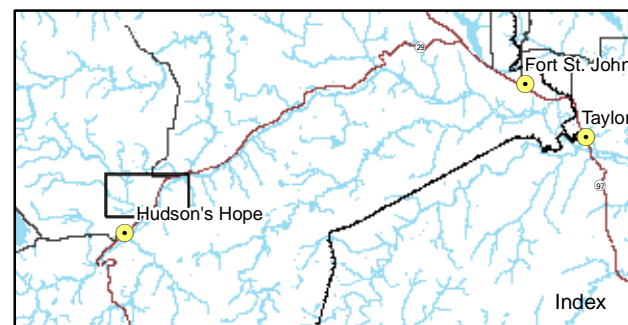
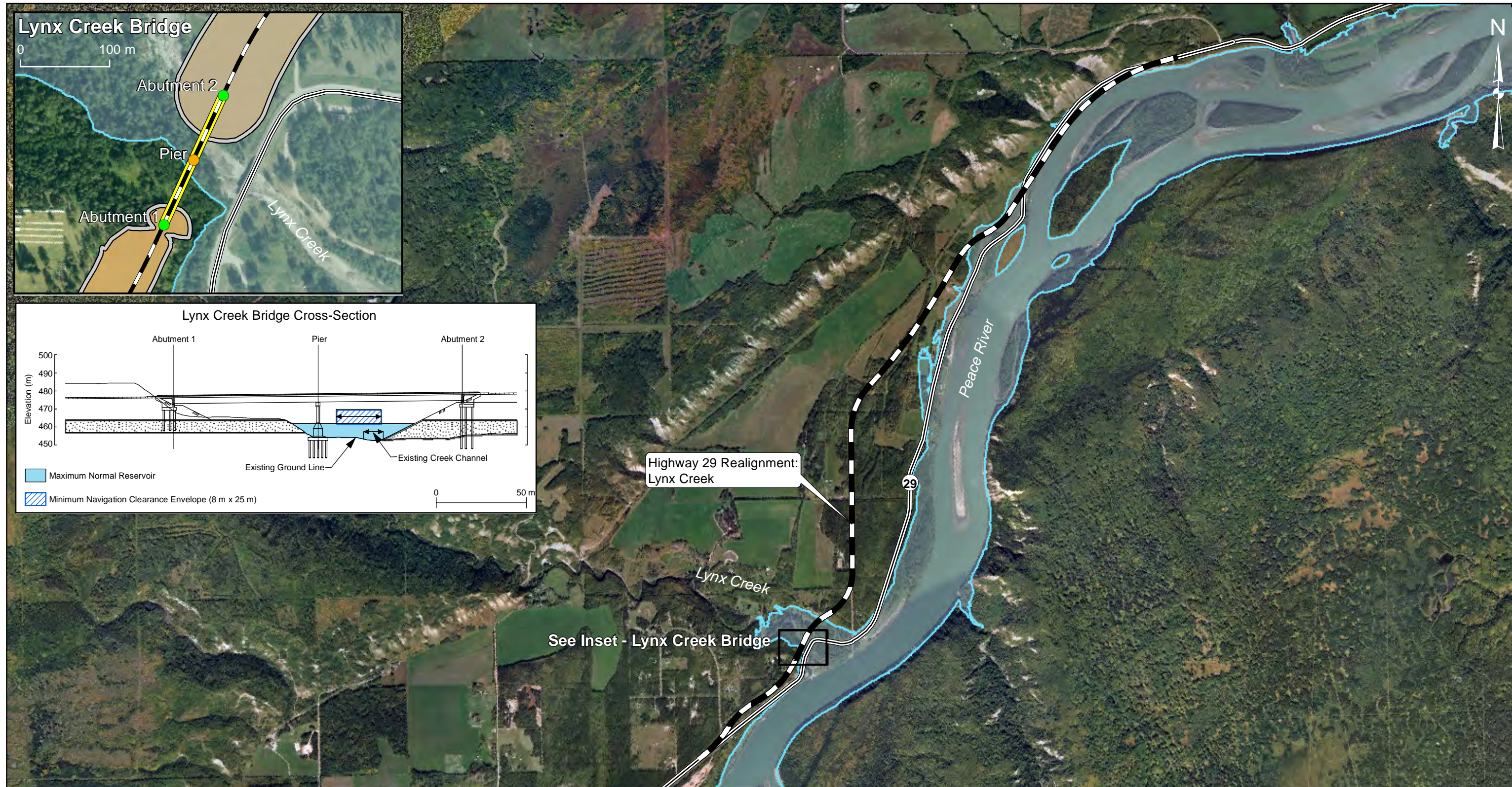
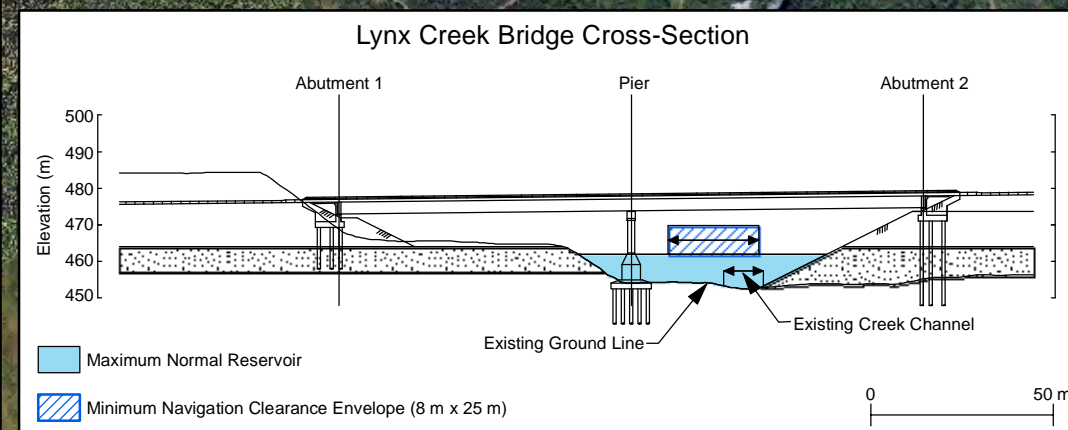
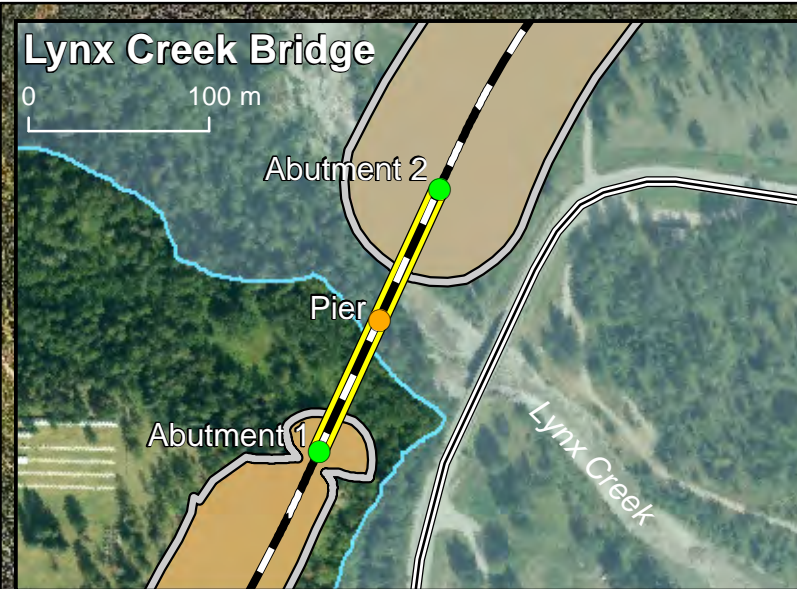
1:134,000 0 1.5 3 6 km



Figure 1: Location of Highway 29 realignment segments

Date	Dec 9, 2019	DWG NO	1016-N11-00712	R 0
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Construction of the Site C Clean Energy Project is subject to required regulatory and permitting approvals.



Map Notes:

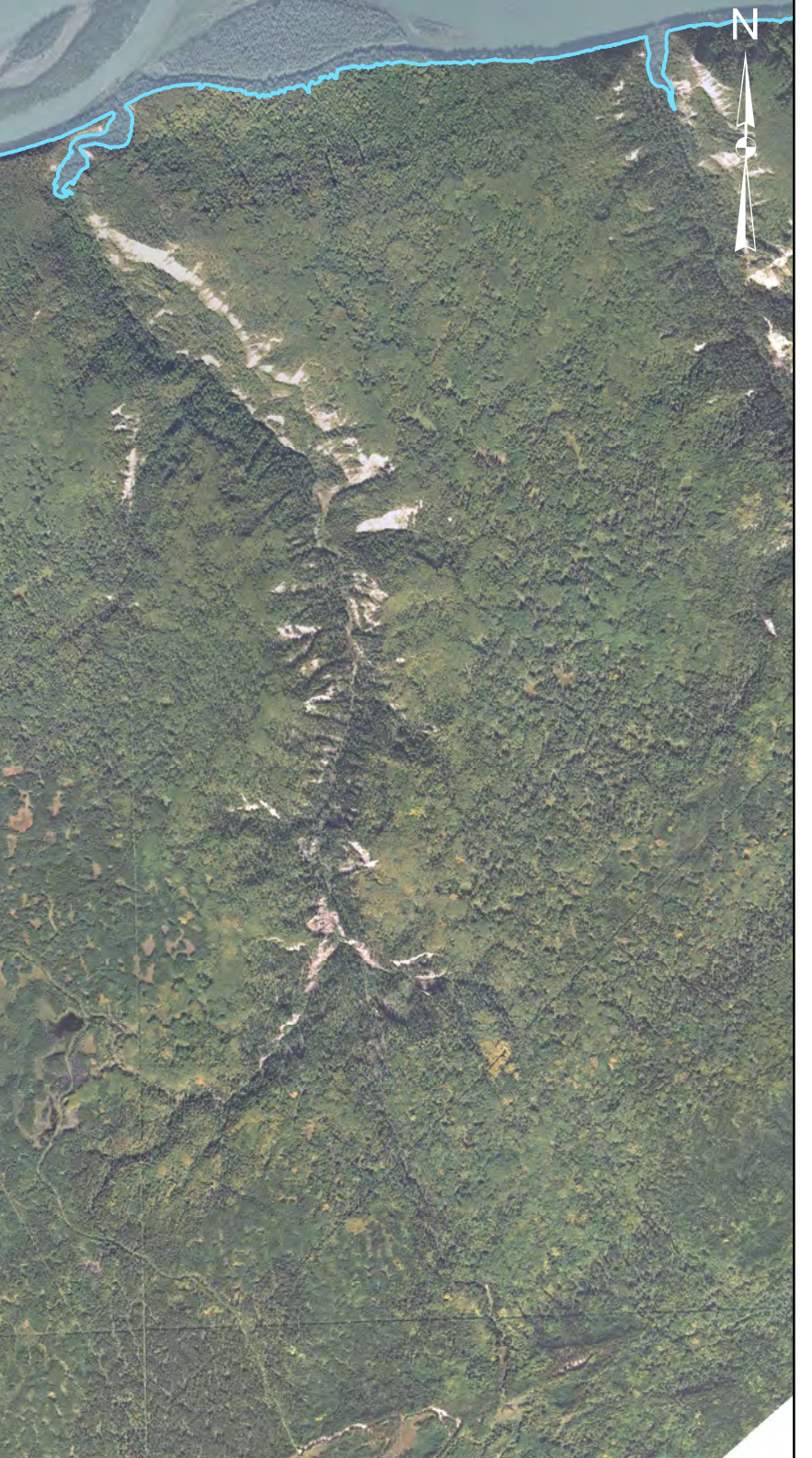
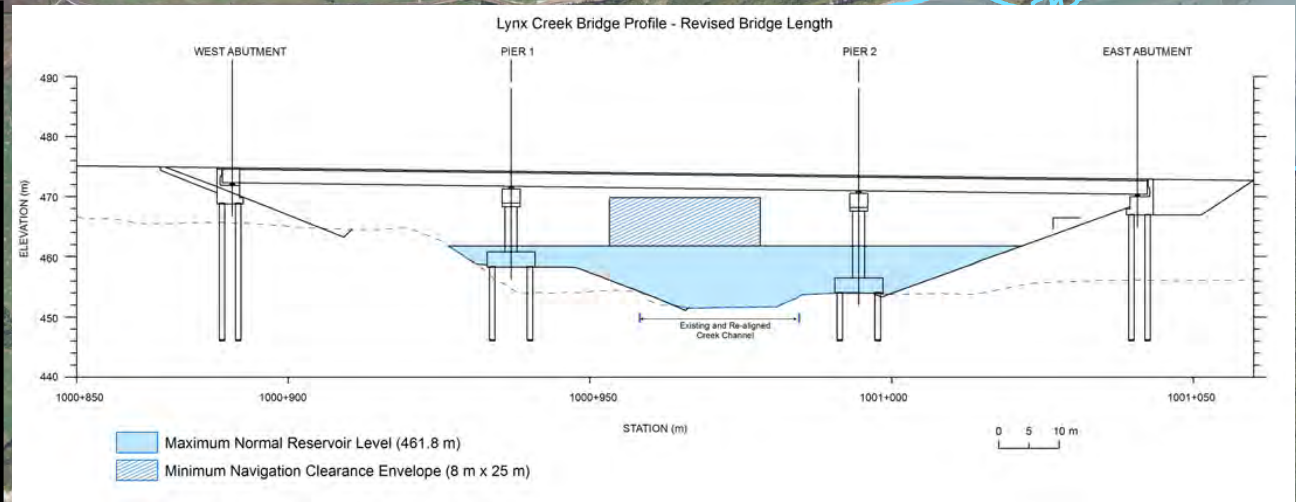
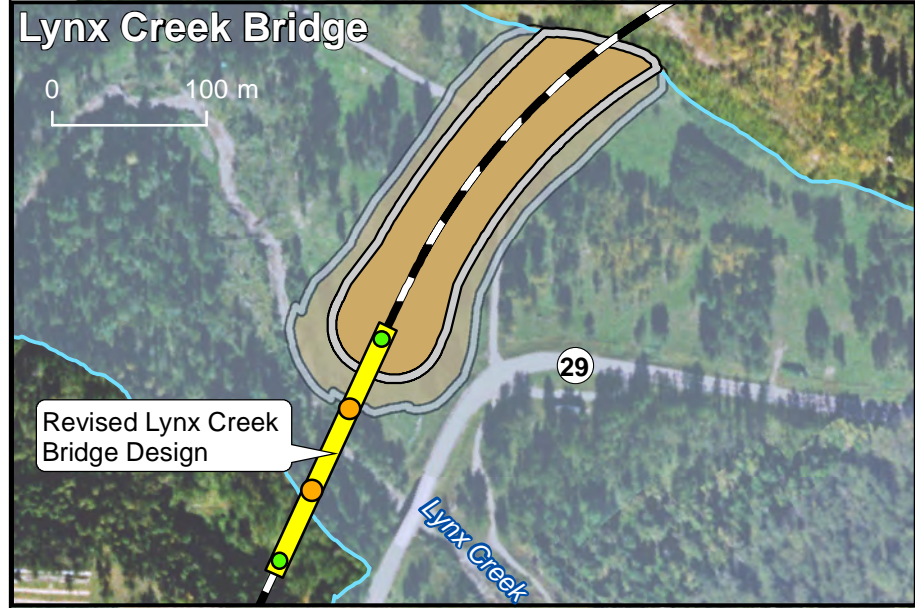
1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Orthophotos created from 1:40,000 photos taken Sept 10th 2007; 1:15,000 photos taken Aug 26, 2011; 1:5,000 photos taken Aug 26, 2011; TRIM
4. Proposed maximum normal reservoir level (full supply level-461.8 m) from Digital Elevation Models (DEM) generated from LiDAR data acquired July/Aug 2006.
5. Realignments subject to change.
6. Reservoir elevation = 461.8 m does not consider realignments.

Legend

- Highway 29 Realignment
- Proposed Bridge
- Road Embankment
- Pier
- Abutment
- Maximum Normal Reservoir Level (461.8 m)
- Existing Highway 29

1:34,000 0 1 km

<p>Figure 4.28 General arrangement of Highway 29 realignment segment at Lynx Creek</p>			
Date	Nov. 23, 2012	DWG NO	1016-C14-B6158-14 R 0



Map Notes:

1. Datum: NAD83
2. Projection: UTM Zone 10N
3. Base Data: Province of B.C.
4. Orthophotos created from 1:40,000 photos taken Sept 10th 2007.
5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LIDAR data acquired July/August, 2006.

- Legend**
- Highway 29 Realignment
 - Revised Lynx Creek Bridge Design
 - Pier
 - Abutment
 - Causeway
 - Maximum Normal Reservoir Level (461.8 m)

1:31,500 0 150 300 m

BC Hydro

Figure 3: General arrangement of Highway 29 realignment segment at Lynx Creek, per proposed revised bridge design (proposed Figure 4.28 Rev 1)

Date	Feb 3, 2020	DWG NO	1016-C14-B6158-14	R 1
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Path: X:\AcGIS\Projects\Regulatory\EAC_Amend\LynxCreek\LynxCreek_HwyRealign_EAC_1016_C14_B6158-14.mxd

Figure 4: Profile of Lynx Creek Bridge, per EAC Schedule A Design (not to scale)

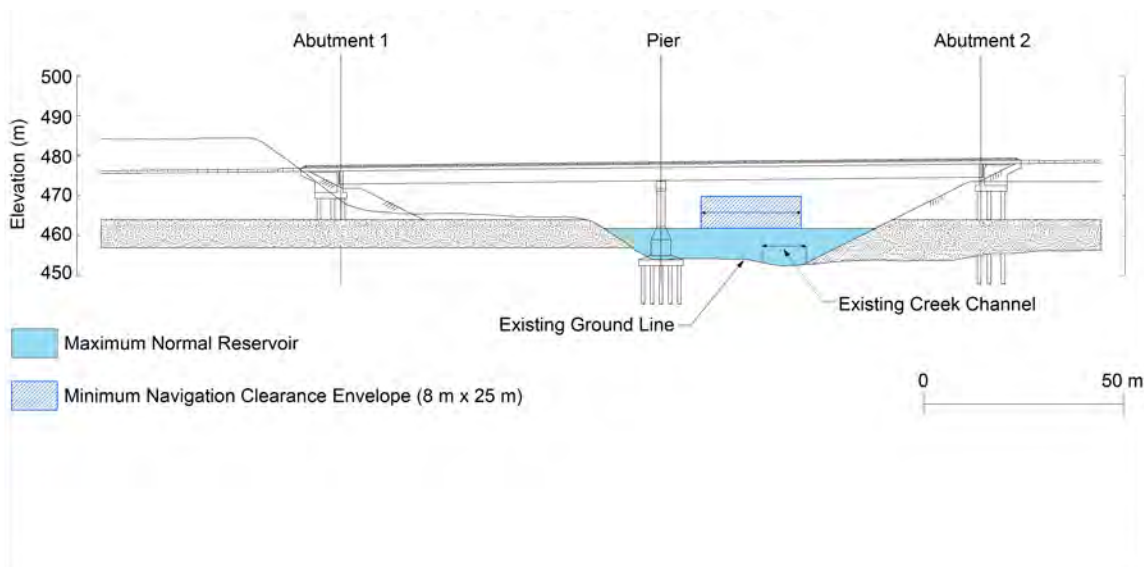
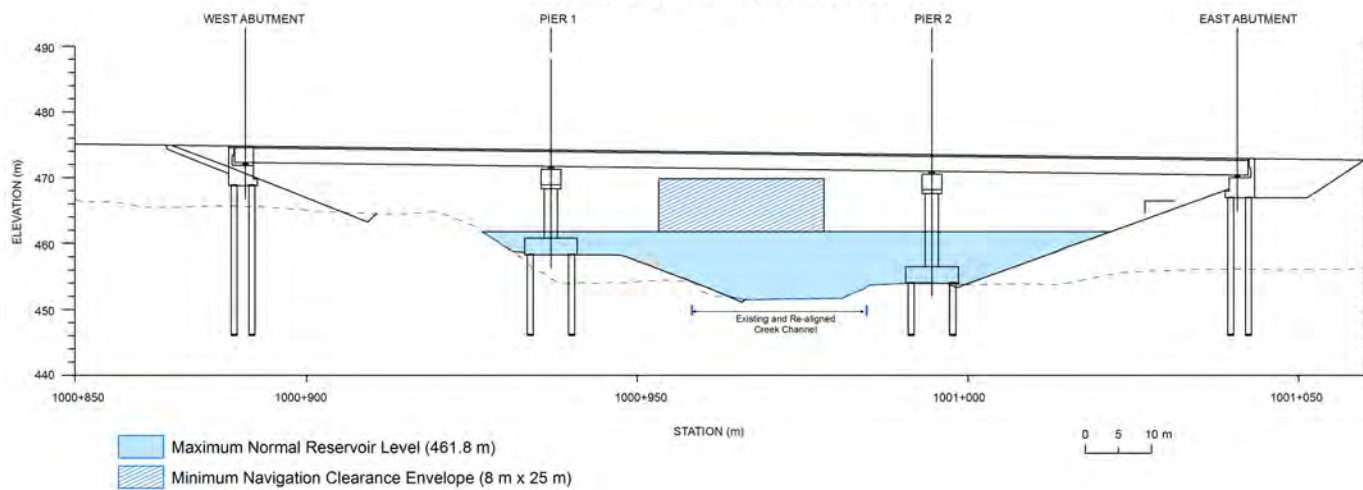


Figure 5: Profile of Lynx Creek Bridge, per proposed revised design (not to scale)





Map Notes:
 1. Datum: NAD83
 2. Projection: UTM Zone 10N
 3. Base Data: Province of B.C.
 4. Orthophotos created from 1:40,000 photos taken Sept 10th 2007; Imagery: © Digital Globe September 19, 2018
 5. Proposed reservoir area (461.8m maximum normal elevation) from Digital Elevation Models (DEM) generated from LIDAR data acquired July/August, 2006.

- Highway 29 Realignment
- EAC Lynx Creek Bridge
- Revised Lynx Creek Bridge Design

- Legend**
- Pier
 - Abutment
 - Maximum Normal Reservoir Level (461.8 m)



BC Hydro

Figure 6: Lynx Creek Bridge - EAC Schedule A Design vs Revised Design

Date	Dec 17, 2019	DWG NO	1016-N11-00668	R 0
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Appendix D

**EAC #E14-02 Schedule A showing the changes proposed by amendment
request in redline (page 4-29)**

1 **4 PROJECT DESCRIPTION**

2 **4.1 Project Location**

3 The Project is a proposed third dam and hydroelectric generating station on the Peace
4 River in northeast B.C., Canada. The Peace River arises in the Rocky Mountain Trench
5 in north-central B.C. and flows east across the provincial border into Alberta and, after
6 turning north and joining the Athabasca and Mackenzie rivers, drains into the Arctic
7 Ocean (Figure 4.1). The Project would be located approximately 62 river kilometres
8 upstream from where the Peace River crosses the B.C. – Alberta border, and
9 approximately 1,300 river kilometres upstream from where the Slave River crosses the
10 Alberta – Northwest Territory border.

11 The dam would be located about 7 km southwest of Fort St. John at Universal
12 Transverse Mercator (UTM) coordinates 629422E, 6229749N (Zone 10N NAD 83)
13 (latitude and longitude of N 56°11'42.27", W 120°54'51.02", respectively). The 83 km
14 long reservoir would extend upstream from the dam, west past Hudson's Hope to the
15 Peace Canyon Dam. The general location of the Project is shown in Figure 4.2.

16 **4.1.1 Natural Elements**

17 The geology in the Peace River region in the area of the proposed Project generally
18 consists of flat to gently dipping sedimentary rocks of Cretaceous age that are about
19 70 million years old. The eastern slopes of the Rocky Mountains contain some limestone
20 deposits, formed from marine sediments laid down about 200 million years ago. These
21 formations also contain coal, petroleum, and natural gas deposits. To the west,
22 interbedded shales and sandstone occur near the surface. The overburden, up to 400 m
23 thick, consists of layers of till and gravel alternating with sands, silts, and clays.

24 The region's upland areas are characterized by a rolling topography, with streams and
25 rivers cutting through the overburden and rock to create valleys. Where the overburden
26 consists primarily of silts and clays, the valley slopes are prone to erosion. The upland
27 plateau is, for the most part, at an elevation of 700 m. Along the Peace River, the valley
28 bottom is at an elevation of approximately 450 m at Hudson's Hope, gradually sloping to
29 an elevation of 410 m at the proposed dam site. The width of the valley varies from
30 about 1 km to 5 km. The north bank of the river has prominent terraces, while the south
31 bank is generally more steeply sloped. For more detail, see Volume 2 Section 11.2
32 Geology, Terrain, and Soils.

33 The major tributaries to the Peace River in the proposed reservoir area are Lynx Creek,
34 Farrell Creek, Halfway River, Cache Creek, and the Moberly River (Figure 4.2). The
35 Peace River and its tributaries support a diverse fish community that supports clear-
36 water and turbid-water sport fish such as suckers, minnows, and sculpins. See Volume 2
37 Section 12 for more information about fish and fish habitat. Natural lakes occur
38 sporadically in the uplands, with the largest being Moberly, Charlie, and Boudreau lakes.
39 Groundwater generally flows towards the Peace River, which acts as a regional
40 groundwater discharge point. See Volume 2 Section 11.4 Surface Water Regime and
41 Volume 2 Section 11.6 Groundwater Regime for more detail on these topics. The rivers
42 and lakes provide recreational opportunities that are discussed in Volume 3 Section 25
43 Outdoor Recreation and Tourism.

1 The climate, topography, and vegetation of the Peace River region in B.C. are more
2 similar to Canada's boreal forests and northern plains than they are to the rest of B.C.
3 The Project is located within the moist, wet boreal white and black spruce subzone of the
4 Peace lowlands eco-section. Within this subzone, the dominant tree cover is trembling
5 aspen, with a mix of deciduous and coniferous forests in the valleys and moist
6 depressions and on north-facing slopes. Grasslands, mostly cultivated, are prevalent in
7 the uplands. Wetlands, muskeg, and riparian areas add to the variety of habitats in the
8 region. See Volume 2 Section 13 Vegetation and Ecological Communities for more
9 detail. This region supports populations of ungulates (e.g., mule deer, elk, moose, and
10 white-tailed deer), fur-bearing mammals, birds, reptiles, amphibians, and insects. See
11 Volume 2 Section 14 Wildlife Resources for more detail.

12 **4.1.2 Human Elements**

13 Archaeological and ethnographic sources indicate that Aboriginal peoples have lived in
14 the Peace River region for thousands of years. Evidence from Charlie Lake Cave, near
15 Fort St. John, dates to approximately 10,500 years ago, although it is assumed that
16 Aboriginal people were living in the area for some time before this (Driver et al. 1996,
17 Driver 1999, Fladmark et al. 1988). Based on the ethnographic record, the Dane-Zaa
18 (also referred to as Beaver) and Tse Keh Nay (also referred to as Sekani) have used
19 and occupied the region the longest (e.g., Jenness 1937). The languages of both the
20 Dane-Zaa and Tse Keh Nay are Part of the Athapaskan language family (Krauss and
21 Golla 1981:67). The Algonquian Cree arrived at the beginning of the fur trade era
22 (Ridington 1981).

23 According to ethnographic sources, the Dane-Zaa used and occupied lands adjacent to
24 the Peace River, from the Peace River Canyon to Lake Athabasca (Ridington 1981).
25 The Tse Keh Nay used and occupied the basins of the Parsnip and Finlay rivers, and
26 the valley of the Peace as far downstream as the modern town of Peace River
27 (Denniston 1981, Jenness 1932). The Algonquian Cree settled into the lower and middle
28 Peace River areas of the traditional Dane-Zaa lands following their arrival in the area in
29 the mid- to late 19th century (Ridington 1981).

30 The first contact with European explorers and fur traders occurred in the late 1790s, as
31 shown on the historic timeline in Figure 4.3. With the Peace River corridor being an
32 important link in the travel route between the Canadian northern plains and the coast,
33 Fort St. John became one of a few established trading posts along this route in the
34 following decades. By the mid-1800s, people began creating more permanent
35 settlements in other parts of the Peace River region.

36 Around 1860, the Peace River region experienced the first of many successive waves of
37 resource development. First came a minor gold rush, followed in the early 1900s by land
38 settlement for farming and ranching. Land clearing for agricultural expansion led to the
39 growth of a small forestry industry. The discovery of coal, also in the early 1900s, was
40 followed by periods of oil and gas exploration in the 1920s and 1930s.

41 In response to increasing development and settlement of the northern regions of western
42 Canada and starting in the late 1800s, First Nations and the federal government
43 negotiated Treaty 8. That treaty defined Aboriginal rights to lands and resources within
44 the area described in Section 4.1.2.1 Aboriginal Lands, including the Peace River region
45 in what is now British Columbia.

1 The next wave of development in the 1940s and 1950s focused on developing major
2 infrastructure to connect the Peace region to the rest of B.C. and Canada, including the
3 Alaska Highway, provincial highway connections south to Prince George, a railway, and
4 an airport just east of Fort St. John. During this period, the region became an important
5 transportation corridor and service centre for northern development. Between the late
6 1950s and 1990s, several industrial facilities for processing oil, gas, and wood were
7 developed in the region. Exploration activities for oil and gas continued. along with the
8 construction and operation of several pipelines. In 1967, the W.A.C. Bennett Dam,
9 located at the head of the Peace River Canyon, was completed, followed by the Peace
10 Canyon Dam in 1980. Another wave of resource development activity began in the
11 late 2000s with the extraction and processing of shale gas from the Montney Formation,
12 the development of several wind farms, and the resurgence of coal mining around
13 Tumbler Ridge.

14 The region's population has grown along with the waves of resource development. The
15 2010 population estimate for Fort St. John and Taylor is about 21,300, with the total
16 population for the region estimated at just over 59,300.

17 **4.1.2.1 Aboriginal Lands**

18 The Project lies within the tract of land described in the following excerpt from Treaty 8
19 and illustrated in Figure 4.4.

20 *“AND WHEREAS, the said Commissioners have proceeded to*
21 *negotiate a treaty with the Cree, Beaver, Chipewyan and other*
22 *Indians, inhabiting the district hereinafter defined and described,*
23 *and the same has been agreed upon and concluded by the*
24 *respective bands at the dates mentioned hereunder, the said*
25 *Indians DO HEREBY CEDE, RELEASE, SURRENDER AND*
26 *YIELD UP to the Government of the Dominion of Canada, for Her*
27 *Majesty the Queen and Her successors for ever, all their rights,*
28 *titles and privileges whatsoever, to the lands included within the*
29 *following limits, that is to say:*

30 *Commencing at the source of the main branch of the Red Deer*
31 *River in Alberta, thence due west to the central range of the Rocky*
32 *Mountains, thence northwesterly along the said range to the point*
33 *where it intersects the 60th parallel of north latitude, thence east*
34 *along said parallel to the point where it intersects Hay River,*
35 *thence northeasterly down said river to the south shore of Great*
36 *Slave Lake, thence along the said shore northeasterly (and*
37 *including such rights to the islands in said lakes as the Indians*
38 *mentioned in the treaty may possess), and thence easterly and*
39 *northeasterly along the south shores of Christie's Bay and*
40 *McLeod's Bay to old Fort Reliance near the mouth of Lockhart's*
41 *River, thence southeasterly in a straight line to and including Black*
42 *Lake, thence southwesterly up the stream from Cree Lake, thence*
43 *including said lake southwesterly along the height of land between*
44 *the Athabasca and Churchill Rivers to where it intersects the*
45 *northern boundary of Treaty Six, and along the said boundary*
46 *easterly, northerly and southwesterly, to the place of*
47 *commencement.*

1 *AND ALSO the said Indian rights, titles and privileges whatsoever*
2 *to all other lands wherever situated in the Northwest Territories,*
3 *British Columbia, or in any other portion of the Dominion of*
4 *Canada.*

5 *TO HAVE AND TO HOLD the same to Her Majesty the Queen*
6 *and Her successors for ever.*

7 *And Her Majesty the Queen HEREBY AGREES with the said*
8 *Indians that they shall have right to pursue their usual vocations of*
9 *hunting, trapping and fishing throughout the tract surrendered as*
10 *heretofore described, subject to such regulations as may from*
11 *time to time be made by the Government of the country, acting*
12 *under the authority of Her Majesty, and saving and excepting such*
13 *tracts as may be required or taken up from time to time for*
14 *settlement, mining, lumbering, trading or other purposes.”*

15 Treaty 8 covers 841,487 km² in what is now the northern half of Alberta, the northeast
16 quarter of British Columbia, the northwest corner of Saskatchewan, and the area south
17 of Hay River and Great Slave Lake in the Northwest Territories. Forty First Nations are
18 signatories or adherents to Treaty 8 and many of them have Indian Reserves held for
19 their use and benefit within the boundaries of Treaty 8. Also located within the
20 boundaries of Treaty 8 are several Métis communities.

21 **4.1.2.2 Nearby Communities**

22 First Nation communities located within 100 km of the Project (Figure 4.5) include First
23 Nation Reserves held by Saulteau First Nations (approximately 60 km southwest of the
24 dam site and 12 km from the nearest project component), West Moberly First Nations
25 (approximately 75 km southwest of the dam site and 15 km from the nearest project
26 component), Halfway River First Nation (approximately 67 km northwest of the dam site
27 and 25 km from the nearest project component), Blueberry River First Nations
28 (approximately 58 km north of the dam site and 42 km from the nearest project
29 component), and Doig River First Nation (approximately 50 km north of the dam site and
30 42 km from the nearest project component).

31 Municipalities in the vicinity of the Project include the City of Fort St. John (approximately
32 7 km northwest of the dam site), the District of Taylor (approximately 16 km downstream
33 of the dam site), the District of Hudson’s Hope (approximately 64 km upstream of the
34 dam site and adjacent to the proposed reservoir), the District of Chetwynd
35 (approximately 70 km to the south of the dam site), and the City of Dawson Creek
36 (approximately 65 km to the southeast of the dam site).

37 **4.1.3 Land Ownership**

38 Land ownership in the vicinity of the Project is shown in Figure 4.6. The majority of land
39 consists of surveyed or unsurveyed provincial Crown land. South of the proposed
40 reservoir, within the transmission corridor, is a small area of privately owned land. Along
41 the length of the proposed reservoir there are several BC Hydro-owned and privately
42 owned parcels within the Peace River valley and on the north bank of the Peace River.
43 There is no directly affected federally owned land near the Project.

1 Since 1957, the Province has held a flood reserve over Crown land lying within the
2 proposed area of the reservoir (Figure 4.7). This notation prevents the construction of
3 permanent structures and exploration for oil and gas, and is discussed in more detail in
4 Volume 1 Section 6 Alternative Means of Carrying Out the Project. Within and around
5 the Project activity zone, other tenures and rights exist for activities that include
6 agriculture, grazing, forestry, oil and gas exploration and production, guiding, and
7 trapping. These tenures are described in more detail in Volume 3 Economic and Land
8 and Resource Use Effects Assessment.

9 **4.1.4 Environmentally Sensitive Areas and Parks**

10 The closest ecological reserve to the Project, Cecil Lake, is located 28 km northeast of
11 Fort St. John and lies outside the Project activity zone. It is a land-based 129-ha area
12 with vegetation and topography that is representative of the ecosystems in the Peace
13 River area of the Alberta plateau. Approximately 11 km southwest of the ecological
14 reserve, also outside the Project activity zone, is a 440-ha area designated by the
15 international ornithology community as an Important Bird Area. The Province has not
16 established any Wildlife Management Areas in northeast B.C.

17 The locations of wetlands and identified ungulate winter range (established under the
18 *Forests and Range Practices Act*) are shown in Figure 4.8. The habitats of provincially or
19 federally listed species are described in Volume 2 Section 13 Vegetation and Ecological
20 Communities and Volume 2 Section 14 Wildlife Resources.

21 The locations of the following provincial, regional and municipal parks are shown in
22 Figure 4.8.

- 23 • Provincial parks:
 - 24 ○ Beatton and Beatton River
 - 25 ○ Butler Ridge
 - 26 ○ Charlie Lake
 - 27 ○ Moberly Lake
 - 28 ○ Pine Le Moray
 - 29 ○ Taylor Landing
 - 30 ○ Kiskatinaw
- 31 • Regional parks:
 - 32 ○ Montney Centennial
 - 33 ○ Spencer Tuck
- 34 • Municipal parks:
 - 35 ○ Alwin Holland
 - 36 ○ Peace Island

37 The two municipal parks are located directly on the Peace River and in close proximity to
38 the Project. Alwin Holland Park will be partially inundated by the proposed Site C
39 reservoir.

1 A new proposed protected area, Peace River Boudreau Lakes, was recommended by
2 the 1999 Dawson Creek and 1997 Fort St. John land and resource management
3 planning processes; however, to date, the area has not been formally designated by the
4 Province.

5 The Peace Moberly Tract is described in the 2006 Peace Moberly Tract Draft
6 Sustainable Resource Management Plan (see reference below) as an area of land
7 approximately 1,090 km² in size and lying between Moberly Lake and the Peace River.
8 The Peace Moberly Tract lies within a greater area identified by the Saluteau and West
9 Moberly First Nations as an 'Area of Critical Community Interest'. The 'Area of Critical
10 Community Interest' is in proximity to the Saaluteau and West Moberly First Nations'
11 reserves and provides access for cultural activities and for hunting, trapping, and fishing.

12 **4.1.5 Current Land Use and Management Designations**

13 Current land use is a reflection of traditional uses and historic settlement patterns in
14 combination with more recent activities involving resource extraction and processing and
15 community development. Human activities are conducted within a context of
16 management objectives articulated in provincial and local government plans and zoning.

17 As illustrated in Figure 4.9, the majority of land surrounding the Project activity zone is in
18 the provincial Agricultural Land Reserve. In addition to farming and ranching, allowable
19 uses within this Reserve include mineral exploration; oil and gas exploration and
20 development; transportation, utility, and communication corridors; recreational
21 developments; and forest management. The Project activity zone is also within the
22 Peace Forest District, which includes the Fort St. John and Dawson Creek Timber
23 Supply Areas and one Tree Farm Licence. The forested areas and lakes to the west and
24 south of the project area are used for hunting, trapping, guiding, and outdoor recreation,
25 and have been identified by the Saaluteau and West Moberly First Nations as an 'Area of
26 Critical Community Interest'. The Province is managing these multiple uses on Crown
27 land from the perspective of integrating environmental and conservation values with
28 resource development, as described in the Land and Resource Management Plans
29 developed in the late 1990s. See Volume 3 Economic and Land and Resource Use
30 Effects Assessment for more information about land use.

31 Within municipal boundaries, the dominant uses of land include residential and
32 commercial development, light industrial development, and roads, supported by
33 institutional facilities for health, education, and safety. Outside municipal and First Nation
34 reserve boundaries, rural residential development tends to be clustered along roads and
35 historic settlement areas.

36 The location of the transportation and municipal infrastructure that supports economic
37 development and human settlement in the region is identified in Figure 4.10. The
38 highways through this region are used by local, commercial, and industrial traffic, as well
39 as by tourists travelling to northern B.C., Alberta, and Alaska.

40 **4.2 Project Evolution**

41 The design of the Project has evolved since the 1982 British Columbia Utilities
42 Commission (BCUC) application. Table 4.1 lists design changes that were made to
43 avoid or mitigate potential effects of the Project.

1 The following subsections describe the components of the Project and the activities
2 during construction and operation of the Project incorporating the design changes listed
3 in Table 4.1. The effects assessments and the proposed mitigation measures described
4 in this Environmental Impact Statement are for the Project components and activities
5 described in Sections 4.3, 4.4, and 4.5 and therefore do not double-count the avoidance
6 and mitigation of potential effects achieved by the design changes listed in Table 4.1.

7 **Table 4.1 List of Design Changes Since the 1982 BCUC Application to Avoid**
8 **or Mitigate Potential Environmental Effects**

Project Component	Valued Component ^a	Effects Avoided or Mitigated	Avoidance or Mitigation Measure
Dam, generating station and spillways	Wildlife Resources	Loss of wildlife habitat	Maximize relocation of surplus excavated material upstream of dam
	Wildlife Resources	Loss of wildlife habitat	Reduction of footprint and disruption of wetland habitat and clearing by relocating worker accommodation
	Wildlife Resources	Loss of wildlife habitat	Minimize footprint on big island downstream of dam
	Fish and Fish Habitat	Dissolved gas supersaturation	Spillway design modified to minimize dissolved gas
Reservoir	Community Infrastructure and Services	Erosion of slopes at Hudson's Hope	Extended shoreline protection
Highway 29 realignments	Community Infrastructure and Services	Potential erosion by reservoir	Realign Highway 29 at Dry Creek and Farrell Creek east
	Agriculture	Loss of agricultural land	Selection of alignment at Lynx Creek that includes a portion of Millar Road
Quarried and excavated construction materials	Wildlife Resources	Loss of bat hibernacula	Elimination of Tea Creek from consideration as a source of temporary riprap
	Human Health	Reducing heavy truck traffic on public roads – lower risk to human safety, less noise and dust	Selection of a conveyor for transporting till from 85 th Avenue Industrial Lands to dam site area
	Wildlife Resources	disturbance to caribou	Restriction on blasting at West Pine quarry to no greater than historical levels during the periods January 16 to March 31 and May 15 to June 14 each year
	Transportation	Traffic congestion in Hudson's Hope and on Highway 29	Source permanent riprap for dam, generating station, and spillways from West Pine Quarry as opposed to Portage Mountain Quarry
	Minerals and Aggregates	Use of aggregate in project area	Source aggregate for Highway 29 realignment from areas that would be inundated

NOTE:

^a Valued components are described in Volume 2 Section 10 Effects Assessment Methodology.

9 Two further changes were made to the design of the Project after the commencement of
10 the effects assessment.

1 The transmission line right-of-way requirements were reduced by changing the design
2 and the sequencing of construction of the two 500 kV transmission lines so that the
3 two existing 138 kV transmission lines could be removed. This sequencing is described
4 in Section 4.3.3; however, the effects assessment is based on the greater width of
5 right-of-way.

6 The capacity of the Stage 2 diversion works described in Section 4.4.3 was increased by
7 increasing the diameter of the diversion tunnels. Volume 2 Section 11.4 Surface Water
8 Regime describes the changes to upstream and downstream water levels during
9 Stage 2 diversion based on the smaller diameter tunnels. The effects assessment is
10 based on the changes described in Volume 2 Section 11.4 Surface Water Regime,
11 except that the description of the effects of the environment on the Project contained in
12 Volume 5 Section 37 Requirements for the Federal Environmental Assessment is based
13 on the larger diameter tunnels.

14 **4.3 Project Components**

15 The components of the Project are:

- 16 • Dam, generating station, and spillways
- 17 • Reservoir
- 18 • Substation and transmission lines to Peace Canyon Dam
- 19 • Highway 29 realignment
- 20 • Quarried and excavated construction materials
- 21 • Worker accommodation
- 22 • Road and rail access

23 These components are described in the following subsections. Design and planning of
24 the Project have continued since submission of the Project Description Report
25 (BC Hydro 2011). The descriptions provided below supersede the descriptions contained
26 in the Project Description Report (BC Hydro 2011). The locations of the Project
27 components and activities are shown in Figure 4.11.

28 Alternative means of carrying out the Project are described in Volume 1 Section 6.0
29 Alternative means of Carrying out the Project. Alternatives that were considered for
30 some of the Project components are described in the following subsections.

31 **4.3.1 Dam, Generating Station, and Spillways**

32 The general arrangement of the dam, generating station, and spillways is shown in
33 Figure 4.12 and an artist's rendition is shown in Figure 4.13.

34 From north to south, the main components of the dam, generating station, and spillways
35 are:

- 36 • The left (north) bank stabilization, a large excavation to remove unstable materials
37 from the bank above the earthfill dam and flatten the slope for long-term stability
- 38 • Two diversion tunnels used for river diversion during construction

- 1 • The earthfill dam across the river valley abutting onto bedrock on the north bank and
2 a buttress of roller compacted concrete (RCC) on the south bank
- 3 • The RCC buttress that would support the south wall of the valley and provide an
4 abutment for the earthfill dam and the foundation for the generating station and
5 spillways
- 6 • The generating station, consisting of power intakes, penstocks (large pipes that
7 convey the water from the intakes to the powerhouse) and powerhouse
- 8 • A spillway with three radial gates and six low level outlets to discharge inflows that
9 exceed the capacity of the generating station
- 10 • A lined approach channel to convey water from the reservoir to the power intakes
11 and the spillways
- 12 • Three 500 kV transmission lines to conduct electricity from the generating station to
13 the substation and transmission lines, which would connect the Project to the bulk
14 transmission system at Peace Canyon Dam

15 The earthfill dam, RCC buttress, power intakes, spillway headworks and associated
16 training walls would impound the reservoir. These structures would be designed and
17 constructed to international and Canadian standards to withstand the normal loads
18 (including self-weight, reservoir and tailwater loads; internal water pressures due to
19 seepage, ice, temperatures; and the interaction between the bedrock and the structures,
20 as well as loads resulting from extreme floods and earthquakes).

21 An understanding of the consequences of dam failure underlies several principles in the
22 Canadian Dam Association (CDA) Dam Safety Guidelines (CDA 2007) and is used to
23 establish two principle design criteria, the inflow design flood, and the earthquake design
24 ground motion. BC Hydro has adopted the highest dam classification for Site C. This
25 results in the highest standard for the inflow design flood and earthquake design ground
26 motion.

27 The inflow design flood adopted for Site C is the probable maximum flood, which is
28 defined as the most severe flood that may reasonably be expected to occur at a
29 particular location. Derivation of the probable maximum flood is described in Volume 5
30 Section 37 Requirements for the Federal Environmental Assessment.

31 The earthquake design ground motion adopted for Site C has an annual exceedance
32 frequency of 1 in 10,000. Volume 2 Section 11.2 Geology, Terrain, and Soils provides
33 information on the regional and site-specific seismic hazard assessment.

34 **4.3.1.1 Earthfill Dam**

35 **4.3.1.1.1 General Description**

36 An earthfill dam has been selected as the best dam type for the geological conditions at
37 Site C. A cross-section of the earthfill dam is shown in Figure 4.14. The design of the
38 earthfill dam is conventional and there are many precedents around the world. In fact,
39 the International Commission on Large Dams' World Register of Dams (ICOLD 2011)
40 lists 443 earthfill dams with heights equal to or greater than the height of the proposed
41 earthfill dam at Site C. The design and performance of earthfill dams is well understood.
42 The dam would have a central impervious core with filters on each side of the core,

1 gravel drains on the downstream side of the core and outer shells of sands and gravels.
2 The characteristics of the materials used to construct the dam are described in
3 Section 4.3.1.1.2.

4 Weathered rock and colluvium would be removed from the abutments of the dam. In the
5 riverbed, the shells of the dam would be founded on alluvium that overlies bedrock on
6 the floor of the valley. The impervious core would be founded in a core trench excavated
7 into the shale bedrock. Cement grout would be pumped into a curtain of closely spaced
8 holes drilled along the floor of the core trench to a depth of about 20 m in the riverbed
9 and about 30 m in the north abutment to seal joints and other discontinuities.

10 Table 4.2 lists some earthfill dams that have been constructed on bedrock with similar
11 characteristics as the bedrock at Site C. Two of these dams, Mangla and Karkeh, are
12 located in highly seismic areas and have a maximum design earthquake (MDE) of 0.4 g
13 compared to 0.25 g at Site C.

14 **Table 4.2 Earthfill Dams Built on Bedrock Similar to Site C**

Name (Country)	Year Constructed	Height (m)	Foundation
Bath County Upper Dam (USA)	1985	146	Shale interbedded with sandstone and siltstone
Mangla Dam (Pakistan)	1967	136	Claystone and siltstone of Siwalik (fresh water deposited) formations with bedding planes up to 1 m thick and bentonite seams. Strength of claystone very similar to shale at Site C.
Karkheh Dam (Iran)	2000	128	Shale
Ramganga Dam (India)	1970	126	Siwalik formation with alternate bands of shale and sandstone with occasional thin bands of siltstone
Jennings Randolph (USA)	1985	90	Shale
Zahara (Spain)	1994	80	Shale
Oahe (USA)	1948	75	Shale
Gardiner (Canada)	1967	64	Bears paw formation comprising sandstone and clay shale with bentonite lenses
Garrison USA	1953	64	Shale
Goi (Japan)	1995	57	Shale
Balderhead (UK)	1964	48	Shale
Beltzville (USA)	1969	52	Shale
Cowanesque (USA)	1980	46	Calcareous and shaley sandstone with thick beds of shale
Aabach (Germany)	1981	45	Shale
Chatfield (USA)	1975	45	Shale
Waco (USA)	1965	43	Shale with bentonite seams
Tioga Hammond (USA)	1979	43	Shale
Kamenik (Bulgaria)	1994	40	Shale

1 Any seepage through the impervious core would be intercepted by the free-draining filter
2 and drain layers downstream of the core, and conducted to the toe of the dam by a
3 drainage blanket. The gradation of the filters and drains would be designed so that fine
4 material could not be eroded from the core or filters by seepage. The filters would be
5 processed as described in Section 4.4.3 to meet the required gradation.

6 Drainage tunnels in both the left and right abutments would intercept seepage through
7 the abutment rock.

8 The upper Part of the upstream face of the dam would be protected from wave erosion
9 by riprap on a bedding of finer rock.

10 The earthfill dam would be approximately 1,050 m in length. The design elevation of the
11 dam crest (i.e., the top of the dam) would be 469.4 m, approximately 60 m above the
12 present river level, providing a freeboard of 7.6 m above the maximum normal reservoir
13 level (elevation 461.8 m). The selected freeboard is large enough to provide protection
14 from the following environmental factors:

- 15 • With the maximum normal reservoir level:
 - 16 ○ Set-up and waves generated by the wind with an annual exceedance frequency
 - 17 ○ of 1 in 1,000 years coming from the direction that results in the highest waves
 - 18 ○ Landslide-generated waves
 - 19 ○ Seismic seiche and settlements due to the earthquake design ground motion
 - 20 ○ Freezing of the impervious core
 - 21 ○ Malfunction of spillway gates
- 22 • With the reservoir at the maximum flood level (elevation 466.3 m) during passage of
23 the inflow design flood:
 - 24 ○ Seiche and waves generated by the wind with an annual exceedance frequency
 - 25 ○ of 1 in 100 years coming from the direction that results in the highest waves

26 Please refer to Volume 5 Section 37 Requirements for the Federal Environmental
27 Assessment for a discussion of the effects of the environment on the Project.

28 The dam would have a crest width of approximately 10 m and would be constructed
29 higher than the design elevation to allow for settlement of the earthfill.

30 As described in Section 4.4.3, the foundation of the earthfill dam would be isolated from
31 the river by cofferdams so that the construction would take place in the dry. As shown in
32 Figure 4.14, the upstream and downstream cofferdams would be incorporated into the
33 earthfill dam. The space between the upstream cofferdam and the upstream shell of the
34 dam would be filled with surplus materials from the excavations required to construct the
35 Project structures.

36 **4.3.1.1.2 Materials Used to Construct the Earthfill Dam**

37 Preliminary gradations of various fill materials for the dam are shown on Figure 4.15.
38 These gradations may be refined during detailed design.

39 Extensive investigations have been undertaken to identify suitable sources of materials
40 for construction of the earthfill dam (see Section 4.3.5.4). These investigations included

1 laboratory testing to confirm the properties of the proposed source of earthfill material
2 described below.

3 Impervious core (Zone 1 Figure 4.14) would be:

- 4 • Glacial till sourced from the 85th Avenue Industrial Lands (see Section 4.3.5.2) with
5 maximum particle size up to 150 mm and containing a minimum of 20% silt and clay,
6 i.e., 20% finer than 0.075 mm
- 7 • Free of any organics
- 8 • Placed within 2% of its optimum moisture content as determined by standard Proctor
9 compaction tests
- 10 • Placed in a manner to prevent segregation in layers a maximum of 300 mm thick and
11 compacted by a vibratory or pneumatic roller to a minimum dry density equal to 98%
12 of standard Proctor maximum dry density
- 13 • Placed only when temperatures are above freezing
- 14 • Protected from freezing during winter, and any frozen material would be removed
15 prior to placing new material the following season
- 16 • Would have permeability equal to or less than 1×10^{-6} cm/s after compaction
- 17 • Internally stable

18 As conventional for large earthfill dams, the final placement and compaction
19 requirements – including layer thickness, compactor type, and number of roller passes
20 required to achieve the specified density – would be confirmed by a test fill completed
21 prior to placement in the dam.

22 In the vicinity of the left abutment and at the contact with the RCC buttress, impervious
23 core material with a higher plasticity would be selected. It would be placed at or above
24 optimum moisture content, and the layer thickness reduced to 150 mm to provide the
25 best contact.

26 Based on the following testing, the 85th Avenue Industrial Lands was confirmed to be the
27 best source of impervious material for use in the core of the earthfill dam:

- 28 • Soil classification tests (sieve, hydrometer, specific gravity, moisture content, and
29 Atterberg limits)
- 30 • Double hydrometer
- 31 • Standard Proctor compaction
- 32 • Consolidation
- 33 • Triaxial shear strength
- 34 • Permeability
- 35 • Assessment of internal instability in a large permeameter
- 36 • Sand castle
- 37 • Hole erosion test

- 1 • Mineralogical testing X-ray diffraction, X-ray fluorescence, and scanning electron
2 microscope

3 Fine filter (Zone 2A Figure 4.14) would be:

- 4 • Granular free-draining material sourced from the dam site area with a maximum size
5 of 10 mm and containing a maximum of 5% silt and clay
- 6 • Well graded and within its specified gradation limits (D_{15} of fine filter less than
7 0.7 mm)
- 8 • Free of any organics
- 9 • Placed in a manner to prevent segregation in layers a maximum of 500 mm thick and
10 compacted by a vibratory roller to a minimum of 70% relative density

11 The fine filter material particles would have to be sound and durable, and conventional
12 concrete aggregate testing for fine aggregates have been completed on the material.
13 The following tests were performed on samples of granular material from the dam site
14 area to confirm that suitable fine filter could be produced from the materials available at
15 site:

- 16 • Specific gravity and water absorption
- 17 • Magnesium sulphate soundness test
- 18 • Mineralogical testing
- 19 • Organic impurities
- 20 • Petrographic number

21 Coarse filter (Zone 2B Figure 4.14) would be:

- 22 • Free-draining material sourced from the dam site area with maximum size of 50 mm
23 and containing a maximum of 2% fines
- 24 • Well graded within its specified gradation limits (D_{15} of coarse filter to be equal to or
25 less than 5 times D_{85} of fine filter)
- 26 • Free of any organics
- 27 • Placed in a manner to prevent segregation in layers a maximum of 500 mm thick and
28 compacted by a vibratory roller to a minimum of 70% relative density

29 The coarse filter material particles would have to be sound and durable, and
30 conventional concrete aggregate testing for aggregates have been completed on the
31 material. The following tests were performed on samples of granular material from the
32 dam site to confirm that suitable coarse filter could be produced from the materials
33 available at site:

- 34 • Specific gravity and water absorption
- 35 • Magnesium sulphate soundness test
- 36 • Los Angeles abrasion test
- 37 • Micro-deval test
- 38 • Mineralogical testing

1 • Organic impurities

2 • Petrographic number

3 Shell material (Zone 3 Figure 4.14) would be:

4 • Granular free-draining material sourced from the dam site area with maximum size
5 200 mm and containing less than 5% silt and clay fines

6 • Well graded within its specified gradation limits (D_{15} of shell material to be equal to or
7 less than 5 times D_{85} of coarse filter)

8 • Free of any organics

9 • Placed in a manner to prevent segregation in layers a maximum of 600 mm thick and
10 compacted by a vibratory roller to a minimum of 80% relative density

11 Shell material would be the granular material sourced from the required excavations or
12 from the right bank terrace in the dam site area. The following tests were performed on
13 samples of granular material from the dam site to confirm that it would be suitable for
14 shell material:

15 • Gradations

16 • The same tests as listed for coarse filters

17 Riprap bedding (Zone 5D Figure 4.14) would be:

18 • Hard, sound and durable fine rock sourced from the West Pine Quarry (see
19 Section 4.3.5.2) with a maximum size of 250 mm and minimum size of 40 mm

20 • Well graded between its maximum and minimum size (D_{15} of riprap bedding material
21 equal to or less than five times D_{85} of shell material)

22 • Placed in a manner to prevent segregation in layers a maximum of 600 mm thick and
23 compacted by a vibratory roller to a minimum of 80% relative density

24 The material quality would be the same as the riprap; the tests undertaken to
25 demonstrate the suitability of the material in the West Pine Quarry for riprap listed below
26 also apply to riprap bedding.

27 The riprap (Zone 6D Figure 4.14) would be:

28 • Hard, sound, and durable fine rock sourced from the West Pine Quarry (see
29 Section 4.3.5.2) with a maximum size of 1,100 mm and minimum size of 300 mm

30 • Well graded between its maximum and minimum size (D_{15} of riprap to be equal to or
31 less than five times D_{85} of riprap bedding material)

32 • Carefully dumped and dressed in place with a backhoe

33 The following tests were performed on samples of rock from the West Pine Quarry to
34 confirm that suitable riprap and riprap bedding could be obtained from the quarry:

35 • Petrographic analysis (thin section and aggregate type)

36 • Specific gravity and water absorption

37 • Los Angeles abrasion

- 1 • Micro-deval
- 2 • Magnesium sulphate soundness test
- 3 • Freeze and thaw
- 4 • Unconfined compressive strength
- 5 • Unit weight
- 6 • Wetting and drying

7 **4.3.1.2 Approach Channel**

8 The approach channel would convey water from the reservoir to the generating station
9 and spillways. The depth of water in the approach channel would vary from 24 m to 26 m
10 below the maximum normal reservoir level. The approach channel would be
11 approximately 200 m wide and 900 m (measured along the centreline) from the inlet to
12 the end of the spillways. The approach channel would have an impervious lining to
13 reduce seepage into the underlying bedrock. The majority of the lining would be
14 impervious fill covered by bedding and riprap. In high velocity areas, such as adjacent to
15 the power intakes and spillway headworks, the lining would be RCC or reinforced
16 concrete. Discontinuities exposed in excavated rock surfaces would be sealed before
17 placing the impervious fill lining. The approach channel would be divided into two
18 sections by an 8 m high berm running down the middle of the channel. This berm would
19 enable either section of the approach channel to be dewatered for inspection,
20 maintenance, and repair of the approach channel lining with the reservoir drawn down to
21 an elevation of 440 m.

22 During final design, the use of manufactured geomembranes, such as low density
23 polyethylene for the approach channel lining instead of impervious fill, would be
24 investigated. If manufactured geomembranes are found to be suitable, the amount of
25 glacial till required from the 85th Avenue Industrial Lands would be reduced from that
26 shown in Section 4.3.5.

27 **4.3.1.3 RCC Buttress**

28 As shown in Figure 4.16, the RCC buttress would extend from upstream of the core of
29 the earthfill dam to the downstream end of the spillways. The buttress is divided into the
30 following four major sections:

- 31 • Core buttress, which forms the south abutment of the earthfill dam at the core
- 32 • Dam buttress, which forms the south abutment of the downstream shell of the
33 earthfill dam
- 34 • Powerhouse buttress, which supports the generating station
- 35 • Spillway buttress, which supports the spillways

36 Permanently exposed surfaces of the buttress would be faced with conventional
37 concrete designed for exposure to the climatic conditions at site. As shown in
38 Figure 4.16, a drainage gallery would run through the dam, power, and spillway
39 buttresses, and would be connected to a deep drainage tunnel by a curtain of drilled
40 drain holes. A grout curtain would extend along the south face of the buttress to seal
41 discontinuities in the rock and reduce the seepage into the drainage system.

1 The buttress would transfer the water load in the approach channel and the loads from
2 swelling of the bedrock in the valley wall down to the bedrock in the riverbed level by
3 compression in the inclined buttress.

4 A cross-section of the core buttress is shown in Figure 4.17. The core buttress would be
5 about 133 m long, 4 m greater than the maximum width of the impervious core of the
6 earthfill dam plus the width of the fine and coarse filters. The height of the buttress would
7 be about 65 m. The contact with the earthfill dam would be angled in the downstream
8 direction so that any downstream movement of the earthfill dam would compress the
9 contact. The contact would be faced with conventional concrete and finished to provide a
10 flat surface for sealing the impervious core of the earthfill dam. A grout curtain beneath
11 the core buttress would connect the earthfill dam grout curtain to the grout curtain along
12 the south face of the buttress.

13 A cross-section of the 230 m long dam buttress is shown in Figure 4.18. The dam
14 buttress would have a maximum height of 69 m. The height of the dam fill on the
15 downstream side would vary with the slope of the downstream face of the earthfill dam.
16 There would be no special treatment of the RCC face in contact with the gravel fill of the
17 downstream shell of the earthfill dam.

18 A cross-section of the 170 m long powerhouse buttress is shown in Figure 4.19. The
19 powerhouse buttress provides the foundation for the generating station. The
20 powerhouse buttress would have a maximum height of 56 m to the underside of the
21 power intakes.

22 A cross-section of the 200 m long spillway buttress is shown in Figure 4.20. The spillway
23 buttress would provide the foundation for the spillways. The spillway buttress would have
24 a maximum height of 60 m to the underside of the spillway headworks.

25 The vertical face of the core and dam buttress, the power intakes, and the spillway
26 headworks, and associated training walls would form the north side of the approach
27 channel.

28 **4.3.1.4 Generating Station**

29 The generating station would consist of six power intakes, six penstocks, and a six-unit
30 powerhouse (Figure 4.19 and Figure 4.21). The intakes and penstocks would convey
31 water from the approach channel to the turbines located in the powerhouse.

32 The power intakes would be constructed from reinforced concrete. As shown in
33 Figure 4.19, the intakes would have a bell mouth intake to gradually accelerate the flow
34 from the approach channel to the penstock. There would be a transition from the
35 rectangular shape of the intake water passage to the circular shape of the penstock.
36 Each intake would have a trashrack on the upstream face to prevent large debris from
37 passing through the turbines. Each intake would be equipped with a vertical service gate
38 and hoist capable of closing against full turbine flow in the event of an emergency. The
39 intake gates would be used to seal the intake so that the penstock and turbine could be
40 emptied for routine inspection and maintenance. Slots would be provided in the intakes
41 so that a bulkhead gate could be installed to enable the intake to be emptied, so that
42 gate guides could be inspected and maintained in the dry. The bulkhead gate would be
43 installed using the gantry crane with the intake gate closed so that there would be no
44 flow through the intake.

1 The penstocks would convey water from the intakes to the turbines. The penstocks
2 would be fabricated from steel plate and would have an internal diameter of about
3 10.2 m. The lower bend shown in Figure 4.19 would reduce to the inlet diameter of the
4 turbine, which would be about 8.6 m. A flexible coupling would connect each penstock to
5 the turbine inlets.

6 The powerhouse would contain six generating units with a combined installed capacity of
7 up to 1,100 MW. As shown in Figure 4.12, the powerhouse would be located
8 immediately upstream of the spillways. As shown in Figure 4.19, the generating station
9 would consist of a reinforced concrete substructure and a structural steel superstructure
10 clad with painted insulated metal siding.

11 Vertical axis Francis turbines would be used. The output of the turbines would be
12 controlled by high pressure hydraulic governors. Slots would be provided at the ends of
13 the draft tubes so that stoplogs could be installed to enable the draft tube to be emptied
14 so that the turbine could be inspected and maintained in the dry. The stoplogs would be
15 installed using the gantry crane on the draft tube deck when the turbine shuts down so
16 that there would be no flow through the turbine.

17 Two sumps would be located at the bottom of the superstructure. These sumps would
18 contain the pumps required for emptying the turbines for inspection and for discharging
19 building drainage, which would be pumped through an oil/water separator before
20 discharging into the river.

21 The generators would be air cooled. Each generator would be connected to a
22 transformer located upstream of the units, on the the transformer deck. The transformers
23 would step up the generator voltage to the 500 kV transmission voltage. Containment
24 systems would be provided under each transformer with a capacity greater than the
25 volume of oil contained in each transformer. Drainage water from the containment
26 systems would pass through an oil/water separator before discharge to the river.

27 Each pair of transformers would be connected to a 500 kV transmission line via
28 switchgear located between the transformers. The switchgear would enable either or
29 both of the transformers to be connected to the transmission line. The switchgear would
30 be insulated with sulphur hexafluoride (SF₆) gas.

31 Three 500 kV transmission lines would connect the three pairs of units to the substation
32 south of the approach channel.

33 The powerhouse would contain all of the ancillary mechanical and electrical equipment
34 and systems required to support operation and maintenance of the generating
35 equipment.

36 All discharges from the generating station would be conveyed to the river downstream of
37 the dam by the tailrace (see Figure 4.12), which would be protected from erosion by
38 riprap.

39 **4.3.1.5 Spillways**

40 As shown on Figure 4.12 and Figure 4.21, there would be a gated service spillway and a
41 free overflow auxiliary spillway.

42 The gated spillway would be separated into two separate compartments by a central
43 concrete dividing wall, which would allow one compartment to be isolated and dewatered

1 for inspection, maintenance, and, if necessary, repairs while the other compartment
2 remained in service.

3 The reinforced concrete headworks structure would be equipped with seven radial gates
4 to control the discharges (water releases) from the reservoir. Spillway discharges would
5 be conveyed by a concrete chute into a two-stage stilling basin to dissipate the energy
6 and minimize the erosion of the riverbed during large discharges. The spillway controls
7 would be designed so that spillway gates would open in the event of an outage of the
8 powerplant to provide downstream flows.

9 As shown in Figure 4.20, undersluices would be provided in several of the spillway bays.
10 These sluices would be used during reservoir filling and to draw the reservoir down in
11 the unlikely event that repairs are required in the approach channel.

12 The free overflow auxiliary spillway would provide additional spill capacity in the unlikely
13 event that some of the spillway gates become inoperable during an emergency. The
14 auxiliary spillway would consist of an ungated concrete overflow section and a concrete
15 chute and stilling basin.

16 The spillways would have the following discharge capacities:

- 17 • 11,000 m³/s at the maximum normal reservoir level
- 18 • 16,700 m³/s at the maximum flood level

19 The spillway would be designed to maximize energy dissipation while minimizing the
20 potential for dissolved gas supersaturation.

21 All discharges from the generating station and spillways would be conveyed to the river
22 downstream of the dam by the discharge channel (see Figure 4.12), which would be
23 protected from erosion by riprap.

24 **4.3.2 Reservoir**

25 The Project would create an 83 km long reservoir that would be on average two to three
26 times the width of the current river, which is up to approximately 1 km wide. The
27 reservoir would be a maximum of 55 m deep at the deepest section of the river at the
28 earthfill dam.

29 Table 4.3 lists key reservoir levels. The normal operating range between the maximum
30 normal reservoir level and the minimum normal reservoir level would be 1.8 m.

31 **Table 4.3 Key Reservoir Levels**

Reservoir Level	Elevation (m)	Comments
Maximum flood level	466.3	Peak reservoir level during passage of the inflow design flood
Maximum normal reservoir level	461.8	Not exceeded during normal operation Only exceeded for short periods during large floods (annual probability less than 1 in 1,000)
Minimum normal reservoir level	460.0	Never below this level during normal operation
Minimum operating level	455.0	Lowest level at which the generating station could be operated if the reservoir had to be drawn down for any reason
Drawdown level	444.0	The lowest level that the reservoir can be drawn down to and pass upstream flow of 1,600 m ³ /s through the spillway low level outlets

Figure 4.22 shows water surface profiles from Peace Canyon Dam to Site C Dam for the existing river and the reservoir for the maximum discharge from Peace Canyon Dam, with the mean annual flow from the tributaries between Peace Canyon and Site C. It can be seen that the reservoir would back up to the tailrace of the Peace Canyon Dam. Figure 4.22 shows how the depth of water increases relative to the existing river levels downstream from Peace Canyon Dam to Site C. The reservoir bathymetry showing the water depths in the reservoir based on LiDAR mapping of the existing topography is contained in Figure 4.23.

Figure 4.24 shows surface area and volume plotted against elevation. The reservoir would have a maximum surface area of approximately 9,330 ha and a volume of approximately 2,310 million m³ at the maximum normal reservoir level. The reservoir would have a minimum surface area of approximately 9,030 ha and a volume of approximately 2,145 million m³ at the minimum normal reservoir level. The normal operating range would provide an active storage volume of 165 million m³. The average residence time of the water in the Site C reservoir would be 22 days.

In addition to the flooding of the Peace River, the lower reaches of several tributaries would be flooded. Table 4.4 presents the increase in surface area and extent of flooding as a result of the Project at the maximum normal reservoir level and the minimum normal reservoir level.

Table 4.4 Extent and Area of Flooding in the Peace River and its Tributaries

River or Tributary	Extent of Flooding (km)		Surface Area (ha)	
	461.8	460.0	461.8 m	460.0 m
Halfway River	15.3	14.5	850	805
Lynx Creek	1.3	1.1	25	21
Farrell Creek	3.6	3.3	58	53
Cache Creek	9.0	8.7	320	305
Wilder Creek	3.2	3.0	30	28
Tea Creek	1.2	1.1	14	13
Moberly River	11.6	11.2	418	399

As described in Volume 2 Appendix B Geology, Terrain Stability, and Soil, Part 2 Preliminary Reservoir Impact Lines, shoreline protection beneath Part of the community of Hudson’s Hope would be constructed prior to filling the reservoir.

4.3.3 Substation and Transmission Line to Peace Canyon

4.3.3.1 General Description

As shown in Figure 4.12, the Site C generating station would be connected by three 500 kV transmission lines to a new substation located to the southeast of the generating station. Two new 500 kV alternating current transmission lines would connect the new Site C substation to the existing Peace Canyon substation, which is the point of interconnection for the Project to the bulk transmission system, a distance of approximately 77 km. These lines would be located within and immediately adjacent to an existing right-of-way as shown on Figure 4.25 and Figure 4.26. This right-of-way is currently occupied by two 138 kV transmission lines, which run from the G.M. Shrum generating station at W.A.C. Bennett Dam to supply power to Fort St. John and Taylor. As shown on Figure 4.26:

- 1 • West of Jackfish Lake Road, the new 500 kV transmission lines would be
2 constructed within the existing 118 m wide right-of-way. To accommodate these
3 transmission lines, the total existing right-of-way would be cleared, extending the
4 clearing by 72 m. A one-time clearing extent up to 14 m beyond the right-of-way
5 would be required to remove any danger trees.
- 6 • East of Jackfish Lake Road, to accommodate the Project access road (see
7 Section 4.3.7) and the new 500 kV transmission lines, the right-of-way would be
8 increased by 34 m. In some areas, it may be possible to reduce the additional
9 widening to 17 m. To accommodate these transmission lines and the Project access
10 road, the clearing extent would be increased between 89 m and 106 m, depending
11 on the road alignment. As a result of the widened right-of-way, no one-time danger
12 tree clearing is required east of Jackfish Lake Road.

13 The Site C substation would include 500 kV to 138 kV step-down transformers to provide
14 service to Fort St. John and Taylor, and allow for the removal of the 138 kV lines. The
15 advantages of connecting Fort St. John and Taylor to the new Site C substation would
16 be:

- 17 • Improvements in system reliability, as they would be connected to the transmission
18 system at a much closer point
- 19 • Reduction in transmission system energy losses for the supply to Fort St. John and
20 Taylor

21 The first of the new 500 kV lines would be constructed along the north side of the
22 existing 138 kV lines from Peace Canyon to the Site C substation (see Figure 4.26).
23 After commissioning of the first new 500 kV line and the substation, the 138 kV lines to
24 Fort St. John and Taylor would be connected to the transformers in the Site C
25 substation. The existing 138 kV lines between G.M. Shrum and the Site C substation
26 would then be decommissioned and removed. The second of the new 500 kV lines
27 would then be constructed in the portion of the right-of-way previously occupied by the
28 138 kV lines. Some portions of the 138 kV lines in the vicinity of G.M. Shrum may remain
29 in-service for local needs.

30 The substation would have space to allow for additional connections to Fort St. John and
31 Taylor in the future at either 138 kV or 230 kV.

32 One or two microwave and communications towers approximately 20 m high would be
33 constructed near the Septimus Siding for system communications. A second tower may
34 be required on the north bank to provide the required coverage. The communications
35 equipment installed would be compatible with the new generation system
36 communication equipment that BC Hydro will be installing in the Project area in the
37 future. These communications upgrades would proceed whether or not the Project
38 proceeds.

39 Access roads would be required for the construction of the transmission lines and
40 maintenance during operation (see Section 4.3.7).

41 **4.3.3.2 Transmission Line Alternatives Considered**

42 In addition to the proposed route, BC Hydro considered the following two alternative
43 routes for connecting the Site C substation to the Peace Canyon substation:

- 1 • Locating the transmission corridor on the north side of the Peace River
- 2 • Connecting via submarine transmission cables in the reservoir

3 **4.3.3.2.1 Alternative 1 – North Transmission Corridor**

4 BC Hydro considered locating two 500 kV transmission lines adjacent to the existing
5 138 kV transmission line. However, because of the geotechnical risk posed by unstable
6 slopes near river crossings, a transmission corridor for the 500 kV lines would be located
7 further north (Figure 4.27). While a corridor on the north side of the Peace River might
8 be technically feasible, it would involve the acquisition of new rights-of-way on
9 approximately 135 parcels of Crown and private land. A potentially feasible route would
10 be 5 km to 10 km longer than the existing corridor on the south side. Total area of this
11 right-of-way would be 1,263 ha.

12 BC Hydro did not believe there was adequate justification to pursue this alternative
13 further because:

- 14 • Of the increased cost of the transmission line
- 15 • It would require the acquisition of rights on 135 parcels of land totaling 1,263 ha
16 while BC Hydro already has a right-of-way on the south bank
- 17 • Widening of the existing right-of-way would have lesser environmental effects

18 **4.3.3.2.2 Alternative 2 – Submarine Transmission Cable Connection between** 19 **Site C and Peace Canyon**

20 BC Hydro examined the concept of connecting Site C to the Peace Canyon station
21 through two 500 kV alternating current submarine cables along the reservoir bottom.
22 Each transmission circuit would be made up of three submarine cables, six in total would
23 be required.

24 The cables would have to be laid on a stable surface and for maintenance requirements,
25 BC Hydro requires a separation between cables of at least 100 m. The separation would
26 be required so that each cable could be raised to the surface for inspection and repair if
27 necessary and then lowered back to the bottom of the reservoir without any risk of
28 contacting other cables. Therefore, a total width of over 600 m would be required to lay
29 the cables.

30 Voltage compensation would be required because the cables would be 70 km in length.
31 Series compensation stations would be required at both Site C and Peace Canyon.

32 Issues with this alternative included:

- 33 • The cost of submarine cables would be in the order of eight to 10 times greater than
34 overhead lines
- 35 • Volume 2 Appendix B Geology, Terrain Stability, and Soil, Part 2 Preliminary
36 Reservoir Impact Lines discusses the stability of the reservoir shoreline. To avoid the
37 risk of burying or damaging the submarine cables, they would have to be routed to
38 avoid areas where slides into the reservoir or materials from the eroding shoreline
39 could reach them. The risk is that it may not be possible to raise a buried cable to the
40 surface for inspection and repair. To avoid the risk associated with the reservoir
41 slopes it would be necessary to lay the cables on flat surfaces such as riverbank

1 terraces or along the existing river channel, which would increase the length of the
2 cables. There are a number of locations where the width of the valley floor is either
3 insufficient to lay the cables or to avoid high banks, where slope stability and erosion
4 would pose a risk to the reliability of the lines. These locations include: river
5 kilometer 45 to 46, Attachie, and river kilometer 84 to 85.

6 • The transmission line would have to be completed prior to reservoir filling so that it
7 would be ready to accept power when the generating station is commissioned and
8 enters into service. Delays to the in-service date so that the cables could be laid from
9 the reservoir surface would cost in the order of hundreds of millions of dollars, due to
10 accumulated interest, and would not be an economically feasible option. The cables
11 would be laid on dry land (e.g., on terraces) prior to reservoir filling, except where it
12 would be necessary to lay the cables in the river to avoid the slope issues described
13 above. Submarine cables are typically laid at sea or on large lakes by specialized
14 cable laying vessels. Since the Peace River in British Columbia is not navigable for
15 large vessels, it would not be possible to use such a vessel for Site C. Therefore, the
16 in-river portion of the cables would have to be laid by a barge fabricated from
17 modular units that could be shipped by road or rail.

18 • Road and rail capacity would limit the spool diameter and the length of cable that
19 could be transported to the site for laying by barge or on land. This would require
20 multiple cable splices, which would decrease the reliability of the cables.

21 In summary, the alternative of connecting Site C to Peace Canyon substations through
22 submarine cables is uneconomic, with higher risks and lower reliability.

23 **4.3.4 Highway 29 Realignments**

24 **4.3.4.1 General Description**

25 Highway 29 connects Hudson's Hope to Fort St. John and runs along the north side of
26 the Peace River. It is a two-lane rural arterial undivided highway under the jurisdiction of
27 the BC Ministry of Transportation and Infrastructure (BCMOTI).

28 Segments of the highway would be flooded by the Site C reservoir, resulting in the need
29 to realign approximately 30 km of existing highway at Lynx Creek, Dry Creek, Farrell
30 Creek, Halfway River, and Cache Creek. A section east of Farrell Creek that would not
31 be flooded by the reservoir would need to be relocated further away from the reservoir
32 shoreline due to the effects of long-term erosion and potential instability (see Volume 2
33 Appendix B Geology, Terrain Stability, and Soil, Part 2 Preliminary Reservoir Impact
34 Lines). The alignments, including bridge cross-sections, are shown on Figure 4.28
35 through Figure 4.33. The lengths of each segment of the highway relocation, including
36 causeway and bridge lengths, are given in Table 4.5.

1 **Table 4.5 Highway 29 Realignment Segments and Respective Watercourse**
2 **Crossing Lengths**

Segment	Total Length of Segment (km)	Causeway Length (m)	Bridge Length (m)	Number of Piers	Bridge Span	Figure Number
Lynx Creek	8.0	290 up to 290 m	160 up to 180 m	4 up to 3	2 up to 4	Figure 4.28 Rev 1
Dry Creek	1.5	N/A	11-m pipe arch culvert up to 200 m	1 up to 3	N/A up to 4	Figure 4.29 Rev 1
Farrell Creek	2.0	160	170 up to 450 m	N/A up to 6	2 up to 7	Figure 4.30 Rev 1
Farrell Creek East	6.0	N/A	N/A	N/A	N/A	Figure 4.31
Halfway River	3.7	0	up to 1,042	12	13	Figure 4.32, Rev 2
Cache Creek	up to 9.0	N/A	up to 700	up to 8	up to 9	Figure 4.33 Rev 1 and 4.33 Rev 1 – Detail

NOTE:

N/A – not applicable

- 3 Where required, navigable clearance envelopes would be 8 m high by 25 m wide.
4 Existing local roads within the realigned segments would be connected to the new
5 highway alignment. Private and commercial driveways would be re-established.
6 Driveway locations would be determined in consultation with private property owners
7 and to the approval of BCMOTI.

8 **4.3.4.2 Alternative Highway Alignments Considered**

9 A number of highway alignment alternatives were developed for each of the segments. A
10 multiple account evaluation process was undertaken to evaluate the alternatives for
11 each segment. Characteristics evaluated included the relative safety, environmental
12 effects (including those on fish, wildlife, and habitat), social effects (including those on
13 property, heritage, and agriculture), and costs of each alternative. The process included
14 workshops in which the characteristics of each alternative were ranked. Workshop
15 participants included representatives of BC Hydro, the Site C Integrated Engineering
16 Team, BCMOTI, and highway design consultants.

17 Each alignment had two options for crossing the watercourse:

- 18 • A short bridge plus a causeway
19 • A long bridge

20 BCMOTI preferred the short bridge options due to lower long-term maintenance costs,
21 so the long bridge options were dropped.

22 **4.3.4.2.1 Lynx Creek Alternatives**

23 Four alignments for the Lynx Creek section were initially considered (BC Hydro, 2009).
24 During public consultation in 2008, property owners expressed a preference for using
25 the existing Millar Road, so two additional alignments using Millar Road were added.

1 The alignments considered were:

- 2 • Three in an inland corridor, located along the toe of the slope along the west side of
3 the terrace
- 4 • One along the reservoir
- 5 • Two in a central corridor using a portion of Millar Road

6 The alignment shown in Figure 4.28 was selected as the preferred alternative. Even
7 though it would have higher cost than the next highest ranked alternative, which was in
8 the inland corridor, this alignment would:

- 9 • Utilize a portion of the existing Millar Road alignment and therefore reduce
10 requirements for private property
- 11 • Affect fewer fields and a relatively small forested area, resulting in reduced potential
12 adverse effects on the natural habitat
- 13 • Require minimal to no in-stream works on the Lynx Creek segment and therefore
14 would have minimal adverse effects on aquatic or riparian habitat
- 15 • Have lower potential for collisions between vehicles and wildlife
- 16 • Have lower potential agricultural effects

17 **4.3.4.2.2 Halfway River**

18 Three alignments for the Halfway River section were considered (BC Hydro 2009). The
19 overriding design consideration at Halfway River is the potential effect of a
20 landslide-generated wave (see Volume 2 Appendix B Geology, Terrain Stability, and
21 Soil, Part 2 Preliminary Reservoir Impact Lines), which affects the vertical road
22 alignment and the design of the bridge.

23 The alignments considered were:

- 24 • One inland. located along the toe of the slope on the west side of the terrace
- 25 • One along the reservoir shoreline
- 26 • One using the inland alignment north of the river, crossing the river at an angle, and
27 using the reservoir shoreline alignment south of the river

28 The alignment shown in Figure 4.32 was selected because it was the lowest overall cost
29 and was considered to have a reasonable balance between the environmental and
30 social factors.

31 **4.3.4.2.3 Cache Creek**

32 Two alignments for the Cache Creek section were considered (BC Hydro 2009). The
33 alignments considered were:

- 34 • One along the reservoir shoreline
- 35 • One inland located along the toe of the slope on the west side of the terrace

36 The alignment shown in Figure 4.33 was selected because it has:

- 37 • Lower cost

- 1 • Less private land requirements
- 2 • Less severed actively farmed land
- 3 • Less agricultural land required for the right-of-way
- 4 • Fewer geotechnical issues

5 **4.3.5 Quarried and Excavated Construction Materials**

6 **4.3.5.1 General Description**

7 A variety of quarried and excavated materials would be required for construction of the
8 dam, generating station and spillways, Highway 29 realignments, access roads and the
9 Hudson's Hope shoreline protection. These materials would be sourced from various
10 locations in the Project vicinity, as shown in Figure 4.11.

11 In the following descriptions, off-site materials refers to materials that are excavated at
12 and transported from a location away from the construction site (off-site) to the site
13 where the materials would be used to construct a Project component. Except where
14 noted otherwise, off-site materials would be transported from the sources to the
15 construction sites by highway-rated trucks on public roads.

16 In the following descriptions, on-site materials refers to materials that would be sourced
17 at the construction site, and come from excavations required for construction of the
18 Project component or from a location within the boundaries of the site.

19 The approximate quantities of material to be used in the Project from each source are
20 shown in Table 4.6 and Table 4.7. The quantities of unsuitable and surplus materials are
21 shown in Table 4.8 and Table 4.9. The volume of unsuitable material and the total
22 volume excavated may vary depending on the yield of the quarries, thickness of topsoil,
23 occurrence of zones of material with gradations or moisture contents outside of the
24 required specifications, and the like. For the purpose of the environmental assessment,
25 reasonable but conservative assumptions (i.e., to give higher quantities) have been
26 made.

27 **4.3.5.2 Off-Site Sources**

28 Development plans for the following off-site quarry and excavated materials sources
29 describing the locations, boundaries and haul routes are provided in the following parts
30 of Volume 1 Appendix C Draft Construction Materials Development Plans:

- 31 • Part 1 – Impervious Till Core Material Source Development Plan (85th Avenue
32 Industrial Lands)
- 33 • Part 2 – Wuthrich Quarry Development Plan
- 34 • Part 3 – West Pine Quarry Development Plan
- 35 • Part 4 – Portage Mountain Quarry Development Plan
- 36 • Part 5 – Del Rio Pit Development Plan

37 The dimensions of the quarries and the excavated materials sources will depend on the
38 method of development adopted by the contractors. Refer to the quarry and excavated
39 materials development plans for potential development methods and dimensions.

1 **Table 4.6 Approximate Quantities of Materials for Dam, Generating Station, and Spillways**

Material Description	Volume Placed (1,000 Compacted m ³)				
	West Pine Quarry	Wuthrich Quarry	85 th Avenue Industrial Lands	Dam Site Area	Total
Impervious	N/A	N/A	2,921	414	3,335
Filters and drains	N/A	N/A	N/A	1,599	1,599
Shell and granular	N/A	N/A	N/A	12,616	12,616
Dam random fill	N/A	N/A	N/A	1,832	1,832
On-site access road	N/A	N/A	N/A	3,733	3,733
Permanent riprap and bedding	869	N/A	N/A	N/A	869
Temporary riprap and bedding	N/A	350	N/A	N/A	350
RCC and concrete aggregates	N/A	N/A	N/A	4,244	4,244
Total	869	350	2,921	24,438	28,578

NOTE:
 N/A – not applicable

2

1 **Table 4.7 Approximate Quantities of Materials for Highway 29, Access Roads, and Hudson’s Hope Shoreline Protection**

Material Description		Volume Placed (1,000 Compacted m ³)						Total
		Portage Mountain Quarry or West Pine Quarry	Inundated Areas Along Reservoir	Road Alignment Excavation	Dam Site Area	Del Rio Pit	Commercial Pits	
North bank – Highway 29 realignment, access roads and reservoir shoreline protection during filling	Riprap and bedding	447	N/A	N/A	N/A		N/A	447
	Granular aggregates (processed)	N/A	484	N/A	N/A	N/A		484
	Fill and borrow	N/A	9,381	830	N/A	N/A	7	10,218
	Concrete aggregates	N/A	N/A	N/A	N/A	N/A	12	12
South bank – access roads	Riprap and bedding	2	N/A	N/A	N/A	N/A	N/A	2
	Granular aggregates (processed)	N/A	N/A	N/A	N/A	50	464	514
	Fill and borrow	N/A	N/A	301	118	200	77	697
	Concrete aggregates	N/A	N/A	N/A	N/A	N/A	16	16
Hudson's Hope shoreline protection	Riprap and bedding	172	N/A	N/A	N/A	N/A	N/A	172
	Granular aggregates (processed)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Fill and borrow	N/A	N/A	306	N/A	N/A	N/A	306
Total		621	9,381	1,437	118	250	1,060	12,868

NOTE:

N/A – not applicable

2

1 **Table 4.8 Approximate Quantities of Unsuitable and Surplus Material for Dam, Generating Station, and Spillways**

Material Description	Volume Placed (1,000 Placed m ³)				
	West Pine Quarry	Wuthrich Quarry	85 th Avenue Industrial Lands	Dam Site Area	Total
Surplus ^a	1,150	915	N/A	N/A	2,065
Unsuitable ^b	N/A	N/A	325	12,085	12,085
Stripping and overburden	242	330	177	20,304	21,053
Total	1,392	1,245	502	32,389	35,528

NOTES:

^a Surplus materials at West Pine and Wuthrich would be stockpiled for usage by BCMOTI or by others; unsuitable material at the 85th Avenue Industrial Lands would be used for final landscaping

^b Unsuitable materials for construction would be relocated as described in Section 4.3.2.3

N/A – not applicable

1 **Table 4.9 Approximate Quantities of Unsuitable and Surplus Materials for Highway 29, Access Roads, and Hudson’s**
 2 **Hope Shoreline Protection**

Material Description	Volume Placed (1,000 Placed m ³)					Total
	Portage Mountain Quarry or West Pine Quarry	Inundated Areas Along Reservoir	Road Alignment Excavation	Dam Site Area	Other Sources	
Surplus ^a	463	N/A	N/A	N/A	100	565
Unsuitable	N/A	N/A	9	N/A	N/A	9
Stripping and overburden	33	761	718	N/A	48	1,560
Total	498	761	727	N/A	148	2,134

NOTES:

^a Surplus material at Portage Mountain and other gravel pits would be stockpiled for usage by BCMOTI or by others

N/A – not applicable

1 **4.3.5.2.1 85th Avenue Industrial Lands**

2 The 85th Avenue Industrial Lands is a 96 ha parcel of land located in the Peace River
3 Regional District, adjacent to the City of Fort St. John. BC Hydro owns all parcels of land
4 within the site. All impervious material (i.e., glacial till) required for the construction of the
5 earthfill dam core and the approach channel lining would be excavated from the
6 85th Avenue Industrial Lands. The impervious core in the closure section of the Stage 2
7 upstream cofferdam (see Section 4.4.3.3) may also be sourced from the 85th Avenue
8 Industrial Lands depending on the suitability of material available on-site.

9 A conveyor would transport material from 85th Avenue Industrial Lands to the dam site
10 area. The conveyor would off-load materials into a large hopper or to a stockpile close to
11 the hopper. Trucks would then be loaded directly from the hopper or by front-end loader
12 from the stockpile and transport the material to the placing location within the dam site.

13 **4.3.5.2.2 Wuthrich Quarry**

14 Temporary riprap and bedding material would be required for construction of parts of
15 cofferdams, for lining parts of the inlet and outlet channels of the diversion tunnels, and
16 for the erosion protection of the access road along the north bank of the river (see
17 Section 4.3.7). The source of this temporary riprap would be the Wuthrich Quarry, which
18 is an existing BCMOTI quarry located approximately 7 km northwest of Fort St. John.
19 Further development by BC Hydro would expand the area that has been excavated by
20 BCMOTI, but would be within the current boundaries of the quarry.

21 Riprap and bedding material would be transported from Wuthrich Quarry to the dam site
22 by highway trucks on existing public roads.

23 **4.3.5.2.3 West Pine Quarry**

24 Permanent riprap and bedding material would be required for the upstream face of the
25 dam, approach channel lining, containment dikes, cofferdams, some parts of the
26 diversion tunnel inlet and outlet channels, the tailrace, the discharge channel, Highway
27 29 construction, Hudson's Hope shoreline protection, and for areas along the reservoir
28 requiring protection during reservoir filling." The source of this permanent riprap and
29 bedding material is the West Pine Quarry, located on provincial Crown land
30 approximately 75 km southwest of Chetwynd along Highway 97 (approximately 160 km
31 from the Project site).

32 There are currently two transportation options under consideration for the permanent
33 riprap and bedding material:

- 34 1. Use the existing railway siding at the quarry and haul the material to the site by
35 rail; one train per day would be required. Riprap and bedding would be unloaded
36 at the Septimus Siding in the dam site area and moved to a stockpile. An
37 extension of the siding may be required within the quarry. Due to breakage
38 during extra handling. More rock would have to be quarried with this option.
- 39 2. Haul the material directly to the dam site area, Highway 29 realignment
40 segments, Hudson's Hope Shoreline Protection, and areas of the reservoir
41 requiring protection during reservoir filling using highway-rated haul trucks on
42 existing public roads (see Section 4.3.7)

1 The transportation option would be selected by the contractor(s) using the riprap and
2 bedding. For the purposes of environmental assessment, the trucking option has
3 been assumed, as while it has less quarrying it has the greater footprint.

4 **4.3.5.2.4 Portage Mountain**

5 Permanent riprap and bedding material for the Hudson's Hope shoreline protection, for
6 the areas along the reservoir requiring protection during reservoir filling, and for
7 Highway 29 construction would be sourced from Portage Mountain, 16 km southwest of
8 Hudson's Hope or from West Pine Quarry, 138 km southwest of Hudson's Hope.
9 Portage Mountain is currently undeveloped.

10 Excavated material would be transported from the quarry to the construction site using
11 highway haul trucks via the access roads described in the development plan and
12 existing public roads.

13 **4.3.5.2.5 Del Rio Pit**

14 Some of the gravel required for the construction of the Project access road and
15 upgrades to the Jackfish Lake Road and other roads on the south bank would come
16 from the Del Rio Pit, an existing gravel source operated by the BCMOTI. The pit is
17 located 50 km north of Chetwynd, B.C., along Jackfish Lake Road, west onto Douglas
18 Road and then onto Del Rio Pit Road.

19 The License of Occupation on Crown lands for the gravel reserve spans approximately
20 142 ha and is traversed by the 138 kV transmission line right-of-way.

21 **4.3.5.2.6 Inundated Areas**

22 Potential aggregate sources along the Peace River and tributary river valleys were
23 identified. At each of the Highway 29 segments requiring realignment or upgrading, and
24 for the Hudson's Hope shoreline protection, the closest sources within the area that
25 would be flooded by the proposed reservoir have been identified as off-site sources for
26 the required construction materials.

27 Where the sources would be at shallow depth after reservoir impoundment, opportunities
28 for enhancement of fish habitat by contouring and habitat complexing would be explored.

29 **4.3.5.2.7 Commercial Pits**

30 Materials sourced from local commercial pits for construction of Highway 29 would
31 include aggregates for the asphalt pavement and concrete.

32 Some fill for the Hudson's Hope shoreline protection could be sourced from local
33 commercial pits.

34 Materials from commercial pits for the Project would be extracted under the terms of the
35 development and other permits for those pits held by the pit owners.

36 **4.3.5.2.8 Area E**

37 Area E has been identified as a contingency pit for gravel to be used for road
38 construction on the south bank or for construction of the earthfill dam. The identified area
39 could provide up to one million m³ of gravel. Area E is adjacent to the Teko Pit, located

1 just west of the confluence of the Peace and Pine rivers. This pit is operated by BCMOTI
2 (east of the rail line) and by CN (west of the rail line).

3 The access road from this area is very steep and, if required, gravel could be hauled by
4 rail from the siding in the Teko Pit to the Septimus Siding.

5 **4.3.5.3 On-Site Sources**

6 **4.3.5.3.1 Highway 29 and Hudson's Hope Shoreline Protection**

7 Materials from excavations required for highway realignment that are suitable as fill
8 would be used for the highway embankments.

9 As described in Volume 2 Appendix B Geology, Terrain Stability, and Soil, Part 2
10 Preliminary Reservoir Impact Lines, the Hudson's Hope shoreline protection would be a
11 combination of a berm and slope flattening. Suitable material from the slope flattening
12 excavation would be used for construction of the berm.

13 **4.3.5.3.2 Dam, Generating Station, and Spillways**

14 Impervious material for construction of cofferdams and lining of disposal areas would be
15 sourced from required excavations and from a source on the north bank outside the
16 limits of the north bank stabilization excavation.

17 About 40% of the fine filter for the earthfill dam would come from a source on the north
18 bank of the river, and the remainder from the south bank terrace downstream of the
19 dam.

20 All of the gravel excavated for the construction of the dam, generating station, and
21 spillways would be used for construction.

22 Aggregates for concrete and RCC and gravel for the shell of the dam would be sourced
23 from the south bank terrace downstream of the dam.

24 **4.3.5.4 Alternative Off-Site Material Sources Considered**

25 The following subsections describe alternative off-site sources of materials that were
26 considered and provide the rationale as to why these sources are not proposed for use
27 in construction of the Project.

28 **4.3.5.4.1 Dam, Generating Station, and Spillways**

29 **Impervious Material**

30 Reconnaissance studies concluded that suitable impervious material was likely to be
31 found on the north side of the Peace River close to the dam site area, and was unlikely
32 to be found on the south side.

33 Geotechnical investigations were carried out on the north side of the river in 2009 and
34 2010 to identify potential sources of impervious core material. The 2009 investigation
35 focused on understanding the surficial geology and stratification of the area, and
36 identified the most promising source areas for further investigations. The 2009
37 investigations consisted of:

- 38 • 104 auger holes (up to 35 m depth, 125 mm diameter)

- 1 • 7 test pits (up to 5.2 m depth)
- 2 • Laboratory testing on representative samples
- 3 Additional investigations were carried out in 2010 to further define the potential sources.
- 4 The 2010 investigations consisted of:
- 5 • 15 sonic drill holes (up to 29 m depth and 120 mm diameter)
- 6 • 8 test pits (up to 8.3 m depth)
- 7 • 6 piezometers installed for groundwater level monitoring
- 8 • Laboratory testing on representative samples
- 9 Of the potential sources investigated on the north bank, the 85th Avenue Industrial Lands
- 10 were selected as the source of the impervious fill because it:
- 11 • Is close to the dam site area
- 12 • Has best gradation and plasticity
- 13 • Would require minimal moisture conditioning, as it has an average natural moisture
- 14 content that is 1.3% dry of average optimum moisture content
- 15 • Can be compacted to a high density with an average dry density of 2,094 kg/m³
- 16 standard Proctor maximum dry density
- 17 • Has the highest shear strength, varying from 32 to 35 degrees
- 18 • Is a more consistent product and in greater thickness, meaning that little material
- 19 would be wasted
- 20 • Has less topsoil cover

21 **4.3.5.4.2 Temporary Riprap**

22 Tea Creek, located 6 km upstream of the dam on the north bank, was originally
23 considered as the source for temporary riprap for the dam site. The haul distance to the
24 dam is approximately 12 km by existing roads. The deposit is made up of sandstone
25 outcrops of the Dunvegan formation on a bedrock ledge above Tea Creek. The rock,
26 which includes thinly bedded planes of fine-grained sandstone overlain with overburden
27 materials, is approximately 20 m thick.

28 The area was preliminarily assessed for environmental effects and a resident bat
29 population was discovered residing along the outcrop. Other potential effects included
30 the existence of rare species of plants, haul routes on agricultural lands, and the effect
31 on farm operations and residences within 0.9 km to the east and 2.5 km upstream on
32 Tea Creek. Because of these considerations, Wuthrich Quarry was selected as the
33 source of temporary riprap.

34 **4.3.5.4.3 Permanent Riprap**

35 The Portage Mountain Quarry was considered as an alternate source of permanent
36 riprap. Haul routes from Portage Mountain to the dam site area would be through
37 Hudson's Hope:

- 1 • East along Highway 29 to the Alaska Highway, through Fort St. John and via the Old
2 Fort Road
- 3 • South on Highway 29 through Moberly to Jackfish Lake Road and via the Project
4 access road; due to the restricted capacity of Hudson's Hope Bridge, the load size
5 would be limited, potentially increasing the number of trucks
- 6 Due to the potential effect on traffic, this option was dropped, even though it would be
7 \$10 million cheaper than using material from the West Pine Quarry. Of particular
8 concern were the long hills on Highway 29 where trucks hauling riprap would cause
9 considerable delays.

10 **4.3.5.4.4 Highway 29 and Hudson's Hope Shoreline Protection**

11 Other potential riprap sources near to Highway 29 and Hudson's Hope are the Castle
12 formation and the Pringle formation, both on Bullhead Mountain, approximately 6 km
13 north of Portage Mountain. The thinly bedded rock outcrops would result in a lower
14 potential yield than at Portage Mountain, which would increase the cost of production
15 and generate a larger footprint than on Portage Mountain in order to produce the same
16 volume of material. The absorption, specific gravity, and soundness results are below
17 those acceptable for use as riprap. An access road capable of supporting haul units
18 would be required to be constructed for approximately 4 km to the better of the two
19 locations at the Pringle prospect. Therefore, the Bullhead Mountain sources are no
20 longer being considered as potential sources of riprap.

21 **4.3.6 Worker Accommodation**

22 BC Hydro is planning for provision of worker accommodation during the construction
23 phase. The operation phase annual average workforce is predominantly of a regular,
24 long-term nature that would be easily accommodated in local communities.

25 BC Hydro estimates it will generate approximately 10,000 person-years of direct
26 employment during the construction period. The estimated average annual construction
27 phase workforce on-site would be between 800 and 1,600 workers with contingency to
28 accommodate up to 2,200 workers at peak periods and up to 200 additional camp
29 support workers, for a total camp occupancy of up to 2,400, based on single occupancy
30 accommodation units. Approximately 90% of the workforce would be required for
31 construction activities at the dam site. About 10% of the workforce would be required for
32 off-site construction activities, including Highway 29 realignment, Hudson's Hope
33 shoreline protection construction, road works, clearing, material transport, and
34 transmission line construction. The workforce for the Project is expected to be composed
35 of existing local residents, new local residents, and workers from outside the region who
36 will maintain their permanent residence outside the region.

37 Worker accommodation planning is informed by the following objectives and
38 considerations:

- 39 • Safety for public and workers
- 40 • Workforce attraction, retention, and well-being of workers and their families
- 41 • Project construction productivity, cost, and schedule

- 1 • Managing social and housing market effects in nearby communities, including
- 2 opportunities to leave a beneficial housing legacy
- 3 • Support for new workers and their families who choose to move to the region

4 **4.3.6.1 In-community Accommodation**

5 BC Hydro is planning to build approximately 40 new permanent housing units for use by
6 the construction workforce in the Fort St. John area. Following the construction period,
7 these houses would become Part of the long-term housing stock in the area. The
8 development approach of the new housing would be focused on two key objectives:

- 9 • Provide housing suitable for Site C workers and their families during construction
- 10 • Provide housing suitable for community affordable housing post-construction

11 **4.3.6.2 Temporary Accommodation – Dam Site**

12 Temporary accommodations during the construction phase are in the camp located on
13 the north bank of the Peace River (camp) shown in Figure 4.37 of Schedule A. The
14 camp would be removed at the end of the construction phase and the site reclaimed.

15 The camp has a capacity for up to 2,200 workers and up to 200 camp support workers,
16 for a total camp occupancy of up to 2,400, based on single occupancy accommodation
17 units.

18 Camp facilities would be generally self-sufficient and typically include:

- 19 • Dormitories
- 20 • Washing and laundry
- 21 • Kitchen and dining
- 22 • Recreation and leisure
- 23 • General services (e.g., medical, first aid, commissary)
- 24 • Fire protection system
- 25 • Water supply, treatment, and distribution
- 26 • Waste water management
- 27 • Solid waste management system (including use of the regional landfill)
- 28 • Security system
- 29 • Telecommunications
- 30 • Grid electricity and other fuel supply
- 31 • General parking
- 32 • Office buildings
- 33 • Transportation stops

1 A shuttle service would be provided as deemed necessary – from the camp to the
2 Fort St. John area and to the North Peace Regional Airport – for commuters, airport
3 transfers, and leisure transport to town.

4 **4.3.6.3 Temporary Accommodation – Regional Locations**

5 BC Hydro is considering two general locations away from the dam site area for
6 accommodation to support construction activities. The need for these camps, and the
7 size and operating period for each camp, would be determined during the construction
8 phase based on project scheduling and local alternative accommodation options. The
9 sites could include temporary camp units and RV spaces. Local site selection would be
10 done to find a suitable and permissible site, which could be on BC Hydro-owned land,
11 Crown land, or leased private land. Camp facilities and utilities would be designed,
12 constructed, operated, decommissioned, and permitted to be compliant with all
13 applicable regulations. The general areas where these facilities may be placed are
14 based on the location of the construction work sites outside of the dam site area:

- 15 • General vicinity of Hudson’s Hope
- 16 • General vicinity of the upper Jackfish Lake Road area (north of Chetwynd)

17 **4.3.6.4 RV Parks**

18 BC Hydro may secure use of dedicated long-stay RV spaces. These would likely be
19 within the Fort St. John–Taylor and Hudson’s Hope areas, to provide workers with
20 another housing option. BC Hydro would seek an operator, such as the private sector or
21 the local governments, to supply RV spaces, and would require the sites to be built and
22 operated in compliance with all applicable regulations.

23 **4.3.7 Road And Rail Access**

24 Temporary and permanent access roads would be required for the construction and
25 operation phases of the Project, respectively. Where feasible, existing access roads
26 would be used and upgraded as required.

27 The design for new construction and upgrades to public roads would be in accordance
28 with applicable British Columbia and Canadian guidelines, codes, supplements, and
29 technical circulars. Upgrades to the provincial and municipal public roads would meet or
30 exceed existing conditions. Design criteria would be established and approved by the
31 relevant jurisdictional authority. Temporary construction service roads would be
32 designed in accordance with applicable standards for operational equipment and other
33 applicable guidelines.

34 Refer to Volume 4 Appendix B Project Traffic Analyses Report for information on
35 Project-related traffic along each route.

36 Sections 4.3.7.1 and 4.3.7.2 describe the access to the dam site area from the north and
37 south banks, respectively, and Section 4.3.7.3 describes the main access roads within
38 the dam site area.

39 **4.3.7.1 North Bank Access to Dam Site Area**

40 Figure 4.34 shows the permanent and temporary access roads to the north side of the
41 dam site area.

1 Access to the north side of the dam site area from Fort St. John and the Alaska
2 Highway (Highway 97) would be via existing municipal and provincial public roads.
3 Upgrades to the existing roads would include:

- 4 1. Hard-surfacing of 240 Road and the portion of 269 Road south of the intersection
5 with 240 Road
- 6 2. Realigning a portion of Old Fort Road south of 240 Road, as shown on Figure 4.34
- 7 3. Improving public safety on 271 Road between the Wuthrich Quarry and Highway 97
8 by widening the shoulders or adding a paved path
- 9 4. Improving public safety on Old Fort Road north of 240 Road by widening the
10 shoulders or adding a paved path
- 11 5. Potentially improving the Old Fort Road cross-section between 240 Road and the
12 realigned segment, and from the end of the realigned segment to the Howe Pit
13 entrance

14 The total length of required upgrades 1 and 2 above would be about 3.8 km, and the
15 total length of upgrades 3, 4, and 5 above would be up to 7.6 km, depending on the
16 results of an in-service road safety audit, consultation with the public and BCMOTI, and
17 final design considerations. All upgrades to the existing roads listed above would be
18 within the existing rights-of-way.

19 Access to the dam site from Old Fort Road and 269 Road would be controlled 24 hours
20 a day, seven days a week throughout the construction period, so that only authorized
21 traffic would be able to access the dam site area.

22 A conveyor would be installed to transport impervious material from the 85th Avenue
23 Industrial Lands to the dam site area.

24 **4.3.7.2 South Bank Access to Dam Site Area**

25 **4.3.7.2.1 General Description**

26 Existing road networks on the south bank of the Peace River include the partially paved
27 Jackfish Lake Road and an unpaved network of rail, transmission, oil and gas, and forest
28 service roads.

29 Access to the south side of the dam site area from Chetwynd and the Alaska
30 Highway would be via Highway 29, Jackfish Lake Road, and a new 33 km Project
31 access road alongside the existing transmission line corridor (see Figure 4.35). Access
32 to the dam site area via the Project access road would be controlled 24 hours a day,
33 seven days a week throughout the construction period, so that only authorized traffic
34 would use the road. After construction, the Project access road would remain in service
35 to provide access to the eastern half of the transmission line and an alternate access to
36 the dam, generating station, and spillways. While this would be a private road, others
37 would be able to use the Project access road. Discussions would be held with applicable
38 agencies, stakeholders, and First Nations to determine whether enforceable restrictions
39 could be put on the road, or whether this would provide an opportunity to decommission
40 other roads in the vicinity.

1 As shown on Figure 4.35, the CN Rail line to Fort St. John passes through the dam site
2 area on the south bank. A new 2 km siding would be constructed on the north side of the
3 CN Rail line at the existing Septimus Siding.

4 The current network of unpaved resource roads would be upgraded to provide access to
5 the dam site area during the first year of construction, including isolated widening and
6 localized grading, and road base repairs along the 53 km of unpaved resource roads.

7 Upgrades to about 31 km of the unpaved portion of Jackfish Lake Road would be
8 undertaken in Year 3, prior to hauling of riprap from the West Pine Quarry to the dam
9 site area. These upgrades would include road base strengthening and hard surfacing,
10 which may require the widening of some sections.

11 In consultation with BCMOTI, BC Hydro would examine the feasibility, issues, and risks,
12 and costs and schedule for widening the shoulders along the first 30 km of Jackfish Lake
13 Road to meet current BCMOTI rural collector standards, potentially including two 1.5 m
14 wide paved shoulders.

15 **4.3.7.2 Alternate Access Routes Considered**

16 BC Hydro conducted a multiple account evaluation to determine the preferred south
17 bank access road. This process considered the relative safety, environmental effects,
18 social effects, and costs of various options, and was similar to that used for the
19 Highway 29 alternatives (see Section 4.3.4.2).

20 The following alternative alignments for the Project access from Jackfish Lake Road to
21 the dam site area were considered:

- 22 • Alignments 1 and 2, predominantly following the existing 138 kV transmission line
23 right-of-way, with a slight variation at the western end. Alignment 1 follows the
24 transmission line for its whole length, while alignment 2 follows Jackfish Lake Road
25 west from the point where the road meets the transmission line.
- 26 • Alignments 3 and 5, following existing resource development roads and then the
27 transmission line corridor
- 28 • Alignment 4, following existing resource development roads and then a new
29 undeveloped route to the dam site area

30 Alignments 1 and 2 are the shortest, most direct routes.

31 Alignments 2 and 3 had the highest safety rating of the five alignments.

32 Alignments 4 and 5 are more costly than the other three options, and have a greater
33 effect on aquatic and riparian habitat.

34 Alignments 1, 2 and 3 all had very similar ratings for the social and environmental
35 indicators, with the exception of safety as noted above.

36 Based on the above considerations, alignment 2 as shown in Figure 4.35 was selected.

37 **4.3.7.3 Access Roads Within Dam Site Area**

38 As shown on Figure 4.34, the main access roads within the dam site area connecting to
39 Fort St. John would be:

- 40 • Along the north bank of the river (the river road) to Old Fort Road

- 1 • The north bank access road to 269 Road

2 As shown on Figure 4.35, the main access road within the dam site area connecting to
3 Chetwynd via the Project access road would be the Septimus Siding road.

4 Within the dam site area, the contractors would construct many access roads for
5 excavation, relocation of surplus excavated materials, construction of the dam,
6 generating station, and spillways, and for interconnecting the temporary facilities
7 described in Section 4.4.3. The location and routing of these roads would depend on the
8 contractors' methods, sequences, and detailed planning for undertaking the work, and
9 would vary from year to year. Therefore, only the main roads that would be used for
10 construction and remain in place for operations are described herein.

11 The river road would run along the edge of the river on the north bank, connecting Old
12 Fort Road to the downstream end of the diversion tunnels. This road would provide the
13 primary construction access to the dam site area from the east. Excavation of the north
14 bank slope would cut the existing single access road that currently traverses the slope
15 via a series of switchbacks. Until access roads can be established across the north bank
16 excavation, the river road would be the only low-level access to the diversion works and
17 area within the north bank Stage 1 cofferdams (see Section 4.4.3.2). The road would be
18 constructed from gravel and protected from erosion by riprap from the Wuthrich Quarry.
19 After construction, the road would remain as a secondary access to the dam from the
20 north bank.

21 The north bank access road would connect 269 Road to the upper level of the north
22 bank in the dam site area. This would provide access to the north bank camp,
23 warehouse, and contractors' work areas. After completion of the first stage of the north
24 bank excavation, it would connect to temporary roads constructed over the north bank
25 excavation and provide access to the river level. On completion of the Project, this road
26 would become the permanent access across the north bank slope and earthfill dam to
27 the generating station (see Figure 4.12).

28 **4.3.7.4 Transmission Line Corridor Access**

29 There is existing road access along most of the proposed route for the transmission lines
30 as a result of construction and maintenance of the existing 138 kV transmission lines
31 and other developments in the area. Some additional access roads may be required to
32 individual structures and work sites.

33 **4.3.7.5 Reservoir Preparation Access**

34 Access required for reservoir clearing is described in Volume 1 Appendix A Vegetation,
35 Clearing, and Debris Management Plan.

36 For construction access to the Hudson's Hope shoreline protection:

- 37 1. The intersection of Highway 29 and Canyon Drive would be reviewed to confirm
38 estimated traffic delays resulting from construction, and options for mitigating any
39 traffic delays to westbound traffic would be considered, such as:
 - 40 a. Construction of a dedicated left-hand turn slot, or
 - 41 b. Changing intersection priority by revising pavement markings and signing

- 1 2. A paved brake check area would be installed on Canyon Drive before the start of
- 2 the 10% grade. Use of the brake check would be mandatory for all trucks hauling
- 3 riprap from Portage Mountain.
- 4 3. Opportunities for constructing either arrestor beds or runaway lanes or both on
- 5 Canyon Drive above Hudson's Hope would be explored and installed if feasible.

6 **4.4 Construction**

7 The construction activities described in the following subsections are based on the
8 construction planning and assumptions made for the 2010 project cost estimate.
9 Activities may be somewhat different depending on final design and procurement,
10 including contractors' preferences for equipment, sequencing of activities and
11 construction means and methods. However, the types of activities that might be used
12 have been identified and all construction activities would be carried out in accordance
13 with the Project Construction Environmental Management Program described in
14 Volume 5 Section 35 Summary of Environmental Management Plans, with legal
15 requirements applicable to those activities, and with the terms of permits issued with
16 respect to those activities. The work would be contracted on the basis that contractors
17 must commit to compliance with the Project Construction Environmental Management
18 Program described in Volume 5 Section 35 Summary of Environmental Management
19 Plans, legal requirements and the terms of all permits. All construction contracts would
20 contain terms mandating compliance with the commitments made in the contractor's
21 proposal or tender, as applicable.

22 Each of the following subsections describing construction activities should be read with
23 the understanding that the work described therein would:

- 24 • Be conducted in compliance with a decision statement issued by the Minister of
25 Environment of Canada
- 26 • Not commence until after an Environmental Assessment Certificate has been issued
- 27 • Not commence until the permits, licences, authorizations, and approvals necessary
28 to conduct that activity have been obtained
- 29 • Be performed in accordance with the terms of those permits, licences,
30 authorizations, and approvals, and the Construction Environmental Management
31 Program described in Volume 5 Section 35 Summary of Environmental Management
32 Plans

33 Sections 4.4.1 and 4.4.2 describe typical construction activities that are common to
34 multiple project components. They are described separately to avoid the duplication of
35 information.

36 Current protocols for ice management on the Peace River would be unaffected by
37 construction of the Project.

38 **4.4.1 Site Preparation**

39 **4.4.1.1 Clearing**

40 Generally, areas where major earthworks would be carried out, such as in the dam site
41 area, Highway 29 realignment, new all-season access roads, and construction material

1 source areas would require the complete removal of vegetation, including stumps, i.e.,
2 clearing and grubbing. The transmission lines would have a combination of clearing with
3 and without stump removal. The reservoir has a number of clearing treatments
4 prescribed, including some retention of vegetation depending on location and other
5 external factors.

6 The clearing and debris management plan for the Project is described in Volume 1
7 Appendix A Vegetation, Clearing and Debris Management Plan and describes the areas
8 that would be cleared.

9 **4.4.1.2 Grubbing**

10 Grubbing would be carried out in areas where construction activities or quarrying would
11 subsequently be carried out.

12 **4.4.1.3 Stripping**

13 Stripping of topsoil would generally be done with a tracked bulldozer, and the material
14 would be either stockpiled on-site for use during reclamation or hauled to another
15 location for storage.

16 **4.4.1.4 Contaminated Sites**

17 Volume 2 Appendix B Geology, Terrain Stability, and Soil, Part 3 Contaminated Sites
18 Report describes the assessments of potentially contaminated sites undertaken prior to
19 filing this Environmental Impact Statement. Potential contaminated sites would be further
20 assessed prior to the commencement of site preparation activities. Confirmed
21 contaminated sites would be remediated as Part of site preparation.

22 **4.4.1.5 Infrastructure**

23 All infrastructure components such as public utilities and oil and gas structures and
24 buildings would be inventoried and the necessary plans prepared for protection or
25 relocation.

26 **4.4.1.6 Fencing**

27 The perimeter of the dam site area would be fenced and gated as required to prevent
28 unauthorized access.

29 **4.4.1.7 Helipad**

30 Helipad(s) would be constructed on the south bank for emergency evacuation.

31 **4.4.2 Typical Road and Highway Construction Activities**

32 **4.4.2.1 General Activities**

33 General activities would include site preparation as described in Section 4.4.1 and
34 construction of temporary facilities (site offices, utilities, workshops, storage, testing
35 laboratories, vehicle storage and maintenance facilities, hazardous materials storage,
36 fuel storage, and refuelling sites).

1 **4.4.2.2 Gravel Production**

2 Gravel pit development and operation would be required to produce roadway
3 aggregates. Gravel for embankments would be excavated and hauled to the
4 embankment location by trucks. Materials for road sub-base, base, and asphalt
5 would be produced by crushing and screening gravel in the gravel pit to provide the
6 specified gradations.

7 **4.4.2.3 Road and Highway Grading**

8 Grading would include all excavation for roadbeds and drainage works, embankment
9 and causeway construction, and granular aggregate placement to form the roadbed.
10 Unsuitable or surplus excavated material would be disposed of within the proposed
11 right-of-way or designated waste areas.

12 Winter access roadbeds would be constructed mainly from snow and ice, with a
13 minimal amount of soil to assist the freezing of the road, or to provide a more durable
14 surface.

15 **4.4.2.4 Drainage**

16 Drainage works would include ditching, culvert installation, and placement of riprap
17 and bedding. Temporary works, such as diversion of existing watercourses through
18 cofferdams, may be required to facilitate road and bridge construction.

19 **4.4.2.5 Bridge Construction**

20 Bridge works would include driving piles in dry and wet conditions, placing concrete
21 fill and columns for foundation, placing approach works, erecting girders, and placing
22 the bridge deck. Bridge works would also include placement of bridge end fills, and
23 placement of riprap and bedding. Concrete could be provided from existing
24 commercial sources. Concrete batch plants may also be established and would
25 include water supply, cement, and fly-ash storage and facilities for mixing concrete.

26 Temporary bridges and water crossings may include winter crossings, abutment
27 bridges, and pile bridges. Winter crossings may be snow or gravel-covered box
28 culverts. Abutment bridges would include modified railway flatbed cars, or steel
29 girders and timber deck placed on timber crib or concrete abutment footings. Pile
30 bridges would include pipe pile piers installed into the riverbed, with a timber deck
31 supported on structural steel girders.

32 **4.4.2.6 Finishing**

33 Finishing of highways and roads would include the construction of a running surface
34 consisting of gravel, sealcoat, or asphalt pavement. Depending on the running
35 surface and conditions, finishing may also include pavement markings, roadside
36 barrier placement, new and relocated signage, electrical installations, fencing, and
37 landscaping. Asphalt paving would require the establishment of an asphalt plant.

38 **4.4.2.7 Traffic Management**

39 In addition to the Project Traffic Management Plan outlined in Volume 5 Section 35
40 Summary of Environmental Management Plans, traffic management during
41 construction would be in accordance with either the BC *Standard Specifications for*

1 *Highway Construction, the Forest Practice Code – Forest Road Engineering Guidebook,*
2 *or the latest version of the BCMOTI Traffic Management Guidelines for Work On*
3 *Roadways. Standard traffic control measures would be used for guiding traffic during*
4 *construction.*

5 **4.4.2.8 Reclamation and Decommissioning**

6 All temporary construction areas, including laydown areas and temporary access roads,
7 would be deactivated and reclaimed on completion of construction.

8 Abandoned sections of highways and roads would be reclaimed through pavement
9 removal, scarifying of road base, drainage restoration, and landscaping. Reclaimed
10 asphalt would be disposed of or recycled for use elsewhere in the Project.

11 Existing roads and bridges may require widening, brushing, signage, or other
12 improvements to meet the Project needs.

13 **4.4.3 Dam, Generating Station, and Spillways**

14 Construction of the dam, generating station, and spillways and of
15 construction-supporting infrastructure such as worker camps, construction offices,
16 temporary facilities and site access roads would take place within the bounds of the dam
17 site area (Figure 4.36). Within the dam site area, environmental protection zones and
18 restricted activity zones would be established to minimize or avoid potential construction
19 effects in those areas. Construction activities would not be conducted within the
20 environmental protection zones, while restricted construction activities would be
21 conducted within the restricted activity zones. These zones currently include:

- 22 • Restricted activity zones along the north shore of the Peace River, with the
23 construction of the north bank access road and the access road to the end of the
24 conveyor from the 85th Avenue Industrial Lands the only permitted activities
- 25 • Restricted activity zone at the southeast corner, with the construction of the access
26 road from the Septimus Siding the only permitted activity

27 Figure 4.37 depicts key construction activities and their respective locations within the
28 dam site area.

29 The construction of the dam, generating station, and spillways can be categorized into
30 four key stages:

- 31 • Preliminary works
- 32 • Stage 1 – river channelization (Figure 4.38)
- 33 • Stage 2 – river diversion (Figure 4.39)
- 34 • Reservoir filling and commissioning

35 The total construction period would be eight years. The current schedule of key
36 construction activities is summarized in Figure 4.40.

37 **4.4.3.1 Preliminary Works**

38 The first construction activities would be site preparation, construction of some
39 temporary access roads, and construction and setup of the temporary facilities required

1 for construction of the permanent works. The dam, generating station, and spillways
2 would be constructed under several contracts. Each contractor would be responsible for
3 setting up their own temporary facilities; therefore, this stage of the project would overlap
4 the subsequent stages.

5 Excavation of the upper Part of the north bank would commence early in this stage and
6 continue to the end of construction (see Section 4.4.3.3 for a description of activities for
7 the excavation of the north bank).

8 **4.4.3.1.1 Temporary Facilities**

9 After site preparation, levelling ground and placing gravel for the development of
10 temporary facilities, parking areas, staging, and laydown areas would be required. This
11 section describes the temporary facilities that would be set up in the dam site area.

12 **4.4.3.1.2 Utilities**

13 Utilities such as water supply (potable and non-potable), sewer, natural gas, electricity
14 and telecommunications would be installed on-site.

15 On the north bank of the dam site area, electricity would be provided by one or more
16 connections to the existing BC Hydro 25 kV distribution system, which includes duct
17 banks along the Alaska Highway and overhead lines on wood poles. Where it is not
18 possible to use existing duct banks, new duct banks would be constructed. The
19 overhead lines would be upgraded from single phase to three phase by the addition of a
20 three phase cross arm and lines. Some wood poles would be replaced.

21 The preferred route would follow a duct bank from the Fort St. John substation and then
22 via existing poles along 81 Avenue, 100 Street, 85 Avenue, Old Fort Road, and
23 240 Road to the point-of-interconnection.

24 The alternative route would follow duct banks from the Fort St. John substation to the
25 terminus pole at 81 Avenue and 87 Street, then northwest along the Alaska Highway to
26 a terminus pole at the Alaska Highway and 242 Road and then via existing poles along
27 Old Fort Road and 240 Road to the point-of-interconnection. No duct banks exist from
28 81 Avenue and 87 Street to the Alaska Highway and 242 Road; therefore, new duct
29 banks would be constructed.

30 A temporary 138 kV substation would provide temporary construction power on the
31 south bank of the dam site area. The temporary substation would be connected to the
32 existing 138 kV transmission line that crosses the dam site area and would supply 25 kV
33 power to the construction facilities. Construction of the substation would require site
34 preparation and grading, installation of grounding, fencing, concrete footings and
35 electrical equipment, and testing and commissioning. Alternatively, one or more
36 138 kV/25 kV mobile substations could be used. After energization of the new Site C
37 substation, the temporary facilities on the south bank would be decommissioned and
38 removed. The equipment would be redeployed to other BC Hydro site(s).

39 Backup diesel generators would be provided in case of power failures and to provide
40 power prior to the interconnection of the substations to the BC Hydro system.

1 **4.4.3.1.3 Dam Site Temporary Worker Accommodation**

2 Construction of the north bank camp would commence within the first few months after
3 construction commencement. Construction of the south bank camp would commence
4 approximately six to eight months later.

5 **4.4.3.1.4 Waste Treatment and Management Facilities**

6 Waste water treatment facilities would be constructed within the dam site area to treat
7 the waste water from the camps and other temporary buildings. Hazardous waste
8 (including lubricants, antifreeze, etc.) and solid waste would be collected and disposed
9 of.

10 **4.4.3.1.5 Installation and Operation of Temporary Facilities**

11 After site preparation, temporary construction facilities would be erected and installed
12 on-site, including: site offices, workshops, laboratories and testing facilities, storage
13 facilities, fabrication shops, safety, first aid and security facilities, and vehicle
14 maintenance facilities. These facilities would likely comprise prefabricated structures,
15 containers and trailers, but could also include structures requiring erection of structural
16 steel members, cladding and roofing, construction of concrete base slabs, and wood
17 frame construction.

18 **4.4.3.1.6 Explosive Storage**

19 It is anticipated that about one-third of the rock that would be excavated can be broken
20 (ripped) with heavy equipment. However, drilling and blasting would be required for rock
21 that is too hard to rip. Drilling and blasting may be required for excavation of the
22 diversion tunnels (although mechanical excavation by road headers may be an
23 economic option, depending on contractor experience and preference).

24 Packaged explosives such as dynamite and detonators would be stored on-site in
25 explosives magazines constructed at designated areas, a safe distance from other
26 facilities. The explosives would be transported to the site, unloaded, and stored in the
27 magazines. When required, explosives would be loaded and transported to the
28 excavations requiring drilling and blasting.

29 Blasting agents such as ammonium nitrate fuel oil would likely be used for bulk
30 excavations such as the approach channel and foundation of the roller compacted
31 concrete buttress. The components (ammonium nitrate and fuel oil) would be stored
32 separately and only mixed together when placed in the blast holes. Licensed facilities
33 would be used for the maintenance and repair of the trucks that deliver and mix the
34 blasting agents.

35 **4.4.3.1.7 Fuel Storage and Refuelling Sites**

36 Fuel required for all construction equipment would be stored in fuel tanks at a
37 designated location called a tank farm. The tank farm would likely comprise steel fuel
38 storage tanks, erected above ground. The tanks may be constructed on footings or may
39 be placed directly on the levelled natural ground. Bulk fuel would be delivered to the site
40 by road or rail, and transferred from the delivery trucks or tankers into the storage tanks
41 at the tank farm. Spill containment would be provided at the tank farm. Refuelling would

1 not take place adjacent to a body of water unless the area was contained by a dike or
2 other structure. All fuel delivery vehicles would be equipped with spill kits.

3 **4.4.3.1.8 Truck Washing Stations**

4 Truck washing stations would be established at designated locations on both banks.
5 Trucks used to deliver and batch concrete would be washed independently from all other
6 trucks and would have their own designated washing sites. Water used at all of the truck
7 washing sites would be collected and treated.

8 **4.4.3.1.9 Aggregate and Filter Processing Plants**

9 Aggregate (sand, gravel, and crushed stone) would be required for production of
10 concrete and roller compacted concrete, and for the filters in the earthfill dam. Aggregate
11 and filter materials would be processed from sand and gravel excavated from various
12 sources within the dam site area to meet the required specification. Aggregate and filter
13 material processing plants would be located close to the sand and gravel sources.
14 Material would be excavated from the sources and trucked to the processing plant(s),
15 where they would be stockpiled. The gravels would then be put through a crusher to
16 break up the larger stones. Once crushed, the sand and gravel would be screened,
17 washed, and sorted into stockpiles of specified material size. Trucks would be loaded
18 and would then transport the processed materials to their required location for use.
19 Waste water from washing would be collected and treated. Dust generated in the
20 processing operations or as a result of stockpiling would be controlled.

21 **4.4.3.1.10 Concrete Batch Plants**

22 Concrete batch plants would be established on both banks. The plants would include
23 storage facilities for cement, fly-ash, and other additives. The batch plants would have
24 bins for all of the materials required to produce concrete (sand, various sizes of
25 aggregates, cement, fly-ash, and water) and would mix the materials to produce the
26 concrete. Waste water from the batch plants would be collected and treated.

27 Conventional concrete would be deposited into mixer trucks or into buckets loaded onto
28 flatbed trucks, which would transport the concrete to the required locations on-site,
29 where the concrete would be placed, vibrated, and ultimately cured.

30 Roller compacted concrete (RCC) would likely be transported from the batching plant to
31 the buttress and approach channel via a conveyor system. Trucks may also be used if
32 required. The RCC would be dumped from the conveyor onto trucks, which in turn would
33 transport the RCC directly to where it would be placed. After the trucks had dumped the
34 RCC, it would be spread with bulldozers to the approximate lift (layer) height and
35 subsequently compacted using vibratory and drum rollers. Waste water from the batch
36 plants would be collected and treated.

37 **4.4.3.1.11 Relocation of Surplus Excavated Materials**

38 Much of the material excavated for construction of the dam, generating station, and
39 spillways would be unsuitable for construction or would be surplus to construction
40 requirements, and would need to be relocated. The areas shown on Figure 4.37,
41 Figure 4.38 and Figure 4.39 have been designated for relocation of unsuitable and
42 surplus excavated material. Table 4.10 summarizes the source of material, relocation
43 area, and approximate embankment volume.

1 **Table 4.10 Relocation of Surplus Excavated Materials**

Area	Material Source	Embankment Volume (million m ³)
L3	North bank excavations	10.9
L5	North bank excavations	7.7
L6	North bank excavations	1.4
R5a	South bank excavations	6.3
R5b	South bank excavations	1.3
R6	South bank excavations	1.5

2 Work on developing the areas outside of the riparian zones would commence as Part of
 3 the preliminary works. Areas within the riparian zones would be developed as Part of
 4 Stage 1. The areas would be used until completion of the Project.

5 Area L3 would be cleared and grubbed as Part of the site preparation activities. The
 6 remaining areas would require clearing and grubbing in riparian zones. Areas L5, L6,
 7 and R5 would all require construction of retention berms to retain the relocated material
 8 and isolate it from the river.

9 The retention dikes would be gravel berms constructed from excavated river gravels.
 10 The inside face of the gravel berms (i.e., the slope not exposed to the river) and bottom
 11 of the retention areas would be lined with impervious material such as glacial till or
 12 lacustrine material coming from on-site locations. In addition, a capping layer of
 13 impervious material would be overlaid on the relocated materials. This lining and
 14 capping material would minimize infiltration through the relocated materials, and mitigate
 15 possible acidic drainage and metal leaching from the shale bedrock or other surplus
 16 excavated materials (see Volume 2 Appendix B Geology, Terrain Stability, and Soil,
 17 Part 4 Acid Rock Drainage and Metal Leaching Management Plan). Riprap would be
 18 placed on the outer faces of the retention dikes to prevent erosion by the river.

19 Surplus excavated material would be transported via truck to these locations, dumped,
 20 and spread to the ultimate design elevations and slopes. Areas L5 and R5 and the area
 21 between the upstream face of the completed earthfill dam and the upstream cofferdam
 22 would ultimately be completely inundated with water when the reservoir is impounded
 23 near the end of construction.

24 In order to haul excavated materials to Area R5a, a temporary construction access
 25 bridge would be required across the lowest reach of the Moberly River. The temporary
 26 access bridge would have a clear span over the main channel of the Moberly River. This
 27 crossing is temporary as it would only be used for transportation of surplus materials to
 28 Area R5a and would be removed before filling of the reservoir.

29 **4.4.3.2 Stage 1 – River Channelization**

30 Work on Stage 1 would commence after receipt of the applicable federal authorizations.

31 The north and south bank Stage 1 cofferdams shown on Figure 4.38 would confine the
 32 river to its main channel.

33 The nominal crest elevations of the cofferdams would provide a freeboard of over 1 m
 34 above the maximum consolidated ice envelope at the site, determined using
 35 Comprehensive River Ice System Simulation Program model described in Volume 2
 36 Appendix G Downstream Ice Regime Technical Data Report. The crest of the cofferdam
 37 would be about 6 m above the maximum normal river level.

1 **4.4.3.2.1 North Bank Stage 1 Cofferdams**

2 The Stage 1 cofferdams on the north bank would include the cofferdams around the
3 diversion tunnel inlet and outlet locations, as well as along the shore of the central island
4 between these two locations, in order to isolate the north side of the river and enable
5 construction activities on the north bank of the river to commence. These cofferdams
6 would be constructed in riparian zones that would require clearing and grubbing.

7 Gravel from local sources in or near the river would be excavated for cofferdam
8 construction. Gravel extraction would be done, keeping a berm of gravel between the
9 extraction area and the river to provide isolation. The gravel fill would be placed to
10 construct the cofferdams and riprap from off-site locations would be transported via truck
11 to the site and placed on the slopes of the cofferdams for erosion control. In order to
12 prevent seepage under the gravel cofferdams, a vertical cut-off would be installed
13 through the cofferdams to provide an impermeable barrier. The cut-offs would be either
14 a slurry trench wall or a steel secant pile wall.

15 Slurry trench walls would be a trench about 1 m wide, excavated through the cofferdam
16 and the alluvium in the riverbed down to bedrock. During excavation, the sides of the
17 trench would be supported by thick, dense slurry of bentonite clay and water. The trench
18 would then be in-filled with a mixture of cement, bentonite, aggregate, and water to
19 create an impermeable wall. The slurry trench would be excavated by a backhoe or
20 crane equipped with a clamshell or dragline.

21 Secant piles are circular steel pipes installed side by side through the earthfill cofferdam
22 and riverbed alluvium down to bedrock, and connected by a series of interlocks welded
23 onto the sides of the piles to form a continuous interlinked wall of piles. The secant piles
24 would be installed by a crane equipped with a pile driving hammer. If necessary, a
25 down-the-hole hammer could be used to break any large rocks encountered.

26 Once the cut-off walls have been installed, the water on the inside of the cofferdams
27 would be pumped out to dewater or dry out the area where excavation and construction
28 activities would take place.

29 Alternate methods of cut-off construction could be used, depending on contractor
30 preferences.

31 Work would commence on the portion of the earthfill dam located within the north bank
32 Stage 1 cofferdams as soon as the area is dewatered (see Section 4.4.3.3 for a
33 description of the activities for construction of the earthfill dam and Figure 4.38, which
34 shows the excavation for the earthfill dam within the cofferdams).

35 **4.4.3.2.2 South Bank Stage 1 Cofferdams**

36 The Stage 1 cofferdam on the south bank would be constructed along the river edge to
37 isolate the south bank construction activities. All clearing, grubbing, gravel extraction,
38 excavation, gravel fill placement, riprap placement, cut-off installation, and dewatering
39 activities are identical to those described for the north bank Stage 1 cofferdams.

40 Work would commence on the portion of the earthfill dam located within the south bank
41 Stage 1 cofferdams and the south bank structures as soon as the area has been
42 dewatered (see Section 4.4.3.3 for a description of the activities for construction of the
43 earthfill dam and south bank structures and Figure 4.38, which shows the excavation for
44 the earthfill dam and south bank structures within the cofferdams).

1 **4.4.3.2.3 Temporary Construction Access Bridge**

2 A temporary construction bridge across the Peace River would be installed concurrently
3 with the Stage 1 cofferdams and remain operational until the downstream Stage 2
4 cofferdam has been completed (see Section 4.4.3.3), and could be used for access
5 across the river. The bridge would have two lanes and provide easy access between
6 both banks for safety and efficiency reasons. The bridge would not be used for hauling
7 of excavated materials, but would have sufficient capacity to allow unloaded large
8 equipment to cross.

9 The temporary construction bridge would comprise pipe pile piers installed into the
10 riverbed, with a timber deck supported on structural steel girders. The bridge would be
11 multi-span, with a length of about 330 m, and constructed across the Peace River near
12 the toe of the earthfill dam between the north and south bank Stage 1 cofferdams. The
13 north bridge abutment would be constructed as Part of the diversion tunnels outlet
14 cofferdam. A crane located on the cofferdam would install the piles for the first pier, and
15 then the support girders and deck for the first span. In this manner, the bridge would be
16 constructed span by span across the main river channel to the abutment in the south
17 bank Stage 1 cofferdam. Construction of this temporary bridge would take approximately
18 14 weeks. After the Stage 2 downstream cofferdam has been completed, the temporary
19 construction bridge would be redundant as access between the banks would be over the
20 downstream cofferdam, which would provide a wider access with greater load capacity.
21 Therefore, the bridge would be dismantled and removed,

22 **4.4.3.2.4 Diversion Works**

23 Construction of the diversion works would be on the critical path; therefore, work would
24 start as soon as access is available.

25 The diversion tunnels would be constructed through and under the north bank.

26 Construction of the diversion tunnel portals, structures, and tunnels would include the
27 following activities:

- 28 • Excavating overburden and rock at each end of the diversion tunnels (behind the
29 diversion tunnels inlet and outlet cofferdams) to form the portals for the two diversion
30 tunnels, which would include drilling and blasting, and rock support, including rock
31 bolts and shotcrete
- 32 • Excavating rock underground to form the two diversion tunnels, either by drilling and
33 blasting or by a road-header, which is a piece of heavy equipment with a mechanical
34 arm equipped with a rotating cutter bit at the end that excavates the rock
- 35 • Installing rock support, which would include steel ribs at each end of the tunnels,
36 rock bolts and shotcrete
- 37 • Relocating excavated material, loaded onto and transported via trucks, to Area L5
38 (upstream) and Area L6 (downstream)
- 39 • Erecting formwork, fixing reinforcing steel, and placing and curing concrete for the
40 construction of the diversion inlet and outlet structures
- 41 • Erecting formwork and placing and curing concrete to construct the concrete tunnel
42 linings, including cement grouting to fill voids between the concrete and the tunnel
43 roof

- 1 • Installing diversion tunnel gates and hydraulic hoists
- 2 • Excavating diversion tunnel inlet and outlet channels outside the extents of the
- 3 diversion cofferdams (i.e., excavation of river alluvium and gravel from the existing
- 4 riverbed using long-arm excavators; machinery working in water would use
- 5 biodegradable hydraulic fluid)
- 6 • Dewatering (partial drying) wet material from the wet excavations
- 7 • Excavating diversion tunnel inlet and outlet channels inside the cofferdams
- 8 • Installing erosion protection in the diversion tunnel inlet and outlet channels; options
- 9 include riprap both inside and outside the confines of the cofferdams, or placement
- 10 of a concrete slab within the confines of the diversion tunnel outlet cofferdam. Riprap
- 11 installed outside of the cofferdams would be placed underwater in the riparian zone.

12 **4.4.3.3 Stage 2 – River Diversion**

13 After completion of the diversion works, the Peace River would be diverted through the
14 diversion tunnels and the main river channel would be blocked off with upstream and
15 downstream cofferdams (the Stage 2 cofferdams) in order to isolate the area where the
16 earthfill dam would be constructed across the Peace River (see Figure 4.39).

17 River diversion would consist of the following activities:

- 18 • Flooding the tunnels by pumping water from the river to provide balanced water
- 19 levels across the inlet and outlet cofferdams
- 20 • Removing sections of the diversion inlet and outlet cofferdams at the upstream and
- 21 downstream ends of the tunnels with heavy machinery working in water and in the
- 22 riparian zone
- 23 • Placing riprap in water along the bottom of the river channel and along the exposed
- 24 sides of the cofferdam where inlet and outlet cofferdam sections were removed
- 25 • Placing the upstream closure section across the Peace River downstream of the
- 26 diversion tunnel inlet location by trucking rock from off-site locations, dumping it
- 27 above water level, and then pushing it into the river with a bulldozer
- 28 • Placing the downstream closure section using identical procedures to the upstream
- 29 closure section
- 30 • Dumping sand and gravel from trucks running on the rockfill onto the upstream face
- 31 of the rockfill closure sections to reduce flow through the rockfill
- 32 • Transporting gravel from on-site locations, dumping it above water level, and then
- 33 pushing it into the river with a bulldozer to form a platform just above water level
- 34 between the closure sections (Figure 4.39) to form the base of the upstream and
- 35 downstream Stage 2 cofferdams
- 36 • For the upstream cofferdam only, transporting impervious material from the
- 37 85th Avenue Industrial Lands, dumping it above water level, and then pushing it into
- 38 the river with a bulldozer between the rockfill closure section and the gravel platform
- 39 to form the base of the upstream cofferdam

- 1 • Transporting, placing, and compacting gravel from on-site locations and impervious
2 materials from 85th Avenue Industrial Lands to construct the closure sections of the
3 upstream and downstream Stage 2 cofferdams
- 4 • Installing cut-off walls in both the upstream and downstream cofferdams using a
5 slurry trench wall or a steel secant pile wall as described for the Stage 1 cofferdams
- 6 • Dewatering the area between the upstream and downstream Stage 2 cofferdams
7 using pumps and pipes to pump water back to the river
- 8 • Transporting and placing riprap from off-site locations on the exterior faces of the
9 Stage 2 cofferdams

10 **4.4.3.3.1 Earthfill Dam and North Bank Excavation**

11 Significant features of the Project include construction of the earthfill dam that would
12 impound the reservoir, and excavation of overburden material from the north bank to
13 improve the long-term stability of the slope. The construction activities associated with
14 the earthfill dam and the north bank slope would be carried out in parallel over a number
15 of years and would include:

- 16 • Excavating overburden material from the north bank slope with large excavators
- 17 • Excavating overburden, ripping, or drilling and blasting to excavate rock for the dam
18 core trench (foundation)
- 19 • Relocating surplus excavated material via truck to Areas L3 (on the north bank
20 terrace), L5 (upstream), and L6 (downstream)
- 21 • Cleaning the core trench with compressed air
- 22 • Applying shotcrete to the rock surfaces within the core trench to protect the surfaces
23 from weathering
- 24 • Drilling holes into the core trench rock foundation and injecting grout, which is a
25 cement water mixture, into the grout holes
- 26 • Drilling foundation drain holes
- 27 • Constructing an underground drainage system consisting of tunnels and drain holes
28 into the north abutment
- 29 • Loading, transporting, placing, and compacting impervious glacial till from the
30 85th Avenue Industrial Lands for the core of the dam
- 31 • Loading, transporting, placing, and compacting sand and gravel (from the aggregate
32 processing plants located downstream of the dam on the south bank terrace and on
33 the north bank) for the filters of the dam
- 34 • Loading, transporting, placing, and compacting gravel from the south bank terrace
35 gravel pits for the shells of the dam
- 36 • Loading, transporting, and placing riprap (from off-site locations) on the upper portion
37 of the upstream face of the earthfill dam
- 38 • Removing the cut-off wall installed in the downstream cofferdam so as not to impede
39 the flow of water from the drainage zones within the earthfill dam by excavating out

- 1 the slurry trench cut-off wall or removing the secant piles and replacing them with
2 granular material
- 3 • Placing asphalt paving on the powerhouse access road constructed on the
4 downstream face of the dam to access the powerhouse (on the south bank) from the
5 north bank

6 **4.4.3.3.2 South Bank Structures**

7 The construction activities for the south bank structures (RCC buttress, generating
8 station, spillways, and approach channel) would include:

- 9 • Excavating overburden material, ripping, or drilling and blasting, and excavating rock
- 10 • Loading, transporting, and dumping the surplus excavated material, largely to
11 relocation Area R5, using trucks, bulldozers, and graders
- 12 • Placing shotcrete on the rock foundation
- 13 • Drilling grout holes and injecting cement grout into the foundation to seal subsurface
14 cracks and fissures within the foundations
- 15 • Excavating shear zones and filling with plastic concrete
- 16 • Loading, transporting, and placing impervious material from the 85th Avenue
17 Industrial Lands in the approach channel as a liner
- 18 • Loading, transporting, and placing riprap and bedding material from the West Pine
19 Quarry in the approach channel on top of the till lining
- 20 • Loading, transporting, and placing sand and gravel drainage layers
- 21 • Loading, hauling, placing, and curing the RCC buttress
- 22 • Erecting formwork, fixing reinforcing steel, loading, hauling, placing, and curing
23 conventional concrete for the structures
- 24 • Erecting structural steel for the powerhouse superstructure using heavy equipment
25 such as cranes
- 26 • Excavating river gravel in the wet in a riparian zone (i.e., beyond the limits of the
27 south bank cofferdam) to excavate the tailrace channel
- 28 • Placing riprap in the wet
- 29 • Removing the cofferdam cut-off wall in the location of the tailrace
- 30 • Removing cofferdam gravel at the tailrace outlet
- 31 • Fabricating short sections of circular steel penstocks from plate, moving the penstock
32 sections from the fabrication yard by truck, lifting the penstock sections into place
33 with large cranes, and welding the sections together to erect the penstocks
- 34 • Transporting and placing gravel around the penstocks
- 35 • Placing asphalt paving at the permanent powerhouse parking areas
- 36 • Installing spillway gates and hoists
- 37 • Erecting structural steel and deck for the spillway access bridge

- 1 • Installing intake gates and hoists
- 2 • Installing generating equipment in the powerhouse
- 3 • Installing transformers and oil separators
- 4 • Installing ancillary mechanical and electrical equipment within the powerhouse
- 5 • Installing and energizing the transmission lines that connect the powerhouse
- 6 transformers to the substation on the south bank

7 **4.4.3.4 Reservoir Filling and Commissioning**

8 Reservoir filling would take place near the end of construction and would be required for
9 wet testing and commissioning of the units (see Volume 1 Appendix B Reservoir Filling
10 Plan). The preference would be to fill the reservoir in the fall of the year when flows are
11 normally low (after the flood season and before high flows from upstream generation);
12 however, filling may occur at other times of year, depending on the final construction
13 schedule.

14 The sequence of activities for reservoir filling and commissioning would include:

- 15 • Closing the gate in one of the diversion tunnel inlet structures to close off the tunnel;
16 this would reduce the amount of flow diverted through the tunnels and the reservoir
17 level would begin to rise
- 18 • Closing the gate(s) in the second tunnel once the reservoir was high enough to use
19 the spillway undersluices to control the discharge
- 20 • Using the undersluices to control the rate of reservoir filling, including holding the
21 reservoir at specified levels
- 22 • Testing and commissioning the spillway gates
- 23 • Testing and commissioning the intake gates and generating units
- 24 • Constructing an earthfill cofferdam across the diversion tunnel outlet channel
25 (placing gravel in the riparian zone)
- 26 • Dewatering the diversion tunnels by pumping water to the river
- 27 • Placing and curing concrete plugs in the tunnel at the centreline of the earthfill dam
28 to permanently seal the tunnels

29 During testing and commissioning of the generating units, a portion of the river flow
30 would be diverted through the spillway.

31 **4.4.3.5 Demobilization and Reclamation Activities**

32 After completion of the permanent parts of the Project, all temporary structures and
33 construction facilities, including temporary access roads and bridges, would be
34 decommissioned and removed from the site. Grading, landscaping, contouring, and
35 revegetating of the site would be the final activity.

1 **4.4.4 Reservoir**

2 **4.4.4.1 Clearing and Debris Management**

3 Clearing and debris management in the reservoir, including the access requirements,
4 are described in Volume 1 Appendix A Vegetation, Clearing, and Debris Management
5 Plan.

6 **4.4.4.2 Boat Traffic Management**

7 Volume 3 Section 26 Navigation describes the restrictions that would be in place on
8 water access during dam construction and reservoir filling to ensure the safety of
9 boaters, including the proposed public notifications of the restriction by signage and
10 other means.

11 **4.4.4.3 Hudson's Hope Shoreline Protection**

12 As described in Volume 2 Appendix B Geology, Terrain Stability, and Soil, Part 2
13 Preliminary Reservoir Impact Lines, the shoreline protection would be a combination of a
14 granular berm and excavation to flatten the slope. The construction schedule for the
15 Hudson's Hope shoreline protection is shown in Figure 4.42.

16 D.A. Thomas Road in Hudson's Hope, which provides access to the shoreline, would be
17 upgraded to facilitate construction and future access to the proposed shoreline
18 protection.

19 Approximately 9 ha along the berm would require clearing and grubbing of vegetation.

20 Materials required for the construction of the berm include:

- 21 • Clean gravel fill, cobbles or blast rock bedding material, to be placed in the river
22 below the water level
- 23 • Cobbles or blast rock in areas where water emerges on the natural slope to allow
24 free drainage behind the berm
- 25 • Granular materials that form the general fill for the bulk of the berm
- 26 • Riprap and bedding on the exposed surfaces for erosion protection

27 Approximately 270,000 m³ would be excavated to flatten the existing slope in the
28 mid-portion of the shoreline protection (see Figure 13-2 in Volume 2 Appendix B
29 Geology, Terrain Stability, and Soil, Part 2 Preliminary Reservoir Impact Lines). A
30 horizontal bench would be left above reservoir level at the toe of the flattened slope.
31 Riprap and bedding would be placed at the reservoir level below this bench to protect
32 the shoreline from erosion by waves. The material in the slope at this location is granular
33 and meets the specifications for granular fill, so it would be used for construction of the
34 adjacent sections of the berm.

35 The berm would follow the existing shoreline to produce a more natural look and would
36 be constructed by importing borrow materials from a local granular source, either from
37 the inundated area near Lynx Creek or from an adjacent shoreline island downstream
38 from the berm. Both locations would be submerged after reservoir filling.

39 Access to the berm would be required for hauling the construction materials. The
40 proposed access points are the existing D.A. Thomas Road and from within the limits of

1 the slope flattening. Should the island downstream be the source for the imported
2 granular material, then a foreshore tote road would be required between the end of the
3 berm and the island. Adjustment to the existing materials along the shore and capping
4 with some granular materials as a running surface would provide an adequate surface
5 for trucks hauling materials.

6 **4.4.5 Substation and Transmission Line to Peace Canyon**

7 The construction schedule for the substation and transmission line is shown in
8 Figure 4.41.

9 **4.4.5.1 Transmission Line**

10 Construction activities would include gaining access throughout the right-of-way, clearing
11 the right-of-way, constructing access roads for construction, erecting the transmission
12 towers, and stringing the conductors, as well as decommissioning of the existing 138 kV
13 transmission lines, construction areas, and access roads.

14 **4.4.5.1.1 Right-of-Way Clearing**

15 Clearing would be required for the transmission line right-of-way, access roads and
16 laydown areas (see Volume 1 Appendix A Vegetation, Clearing, and Debris
17 Management Plan).

18 Clearing would be required beyond the edge of the right-of-way to remove danger trees.
19 These are trees that either would pose a safety risk during construction or a reliability
20 risk for the lines after construction. The extent of this tree management area (see
21 Figure 4.26) would depend on the height of the trees and the slope of the terrain in
22 relation to the transmission line conductors and transmission line towers. Vegetation
23 would be allowed to regrow within the tree management area.

24 Clearing in the transmission corridor would involve felling, yarding, and disposing of
25 tall-growing vegetation within the clearing boundaries. Various methods, both manual
26 and mechanical, would be used for these activities. The choice of method would depend
27 on site conditions and the contractors' work methods and equipment.

28 The access roads and associated laydown areas would be sited as close to the
29 transmission lines as possible.

30 Due to the proximity of trees to the existing 138 kV transmission lines, the clearing
31 adjacent to the lines couldn't be started until the lines are de-energized, for safety
32 reasons. Therefore, clearing work would occur twice: prior to the construction of each of
33 the two 500 kV transmission lines.

34 **4.4.5.1.2 Tower Foundations and Anchor Installation**

35 Depending on terrain and soil conditions, a variety of foundation and anchor types would
36 be used for the project, including steel grillage footings and rock foundations.

37 Steel grillage footings would be pre-assembled and flown or trucked to each tower site.
38 A small excavation would be required for the grillage, with some larger excavations and
39 backfill required depending on soil conditions. Excavations would typically be conducted
40 by rubber-tire backhoe; blasting may also be necessary in situations where hard rock or
41 large boulders are encountered within the excavations.

1 Rock foundations would require drilling in the rock to install and grout anchor bolts. Then
2 a small concrete foundation would be poured on top. In rock, after removing overburden
3 with a light rubber-tired backhoe, light drilling equipment would be used to provide holes
4 for grouted anchor rods for both the foundation and anchors. Approved corrosion
5 protection would also be applied to metal parts of the foundation and anchors.

6 **4.4.5.1.3 Concrete and Grout Production and Placement**

7 The use of concrete along the transmission line corridor would be limited to tower rock
8 footing pours, requiring concrete to be placed inside a wooden form. Concrete would be
9 produced by a local supplier and, depending on the ease of access to specific sites,
10 would either be transported by concrete truck or by helicopter.

11 Grouting of anchor dowels would be required at rock footing sites. Grout would be
12 trucked in bags to the site and mixed on-site using a small mixer. In areas that would
13 only be accessed by helicopter, the grout would be premixed at a staging location and
14 transported to site via helicopter.

15 **4.4.5.1.4 Assembly and Erection of Transmission Structures**

16 Assembly of the structures would be done by either crane or helicopter, depending on
17 access.

18 For assembly by crane, additional site preparation work would be carried out at each
19 structure site to provide a level bench to assemble the mast and bridge components of
20 the structures and locate the erection crane. The structure components would be
21 delivered to the site and assembled at the structure location. The assembled tower
22 would then be lifted by a crane to a vertical position over the foundation.

23 For assembly by helicopter, the structures would be assembled in a common staging
24 area and lifted to the site by helicopter. The structure would be secured to the
25 foundation, guy wires would be attached, and the structure would be plumbed.

26 **4.4.5.1.5 Installation of Counterpoise**

27 Counterpoise may be required for safety and to protect the circuit in the event of
28 lightning strikes. Counterpoise installation would involve burying a single- or
29 double-galvanized wire in a trench, approximately 0.5 m deep and 0.3 to 0.6 m wide,
30 and excavated into mineral soils. Where practical, the counterpoise would be laid within
31 trenches along access road routes for ease of installation. In rocky areas, the
32 counterpoise wire would be attached to exposed rock between pockets of mineral soil.
33 The need and locations for counterpoise would be determined during detailed design of
34 the transmission line.

35 **4.4.5.1.6 Conductor Stringing**

36 Conductor stringing would involve installing sheaves on structures, stringing pilot lines
37 by helicopter, pulling the conductors, and sagging and clipping the conductors to the
38 insulators.

39 The first activity would be establishing level puller or tensioner sites along the alignment
40 from which the conductor would be installed. The geometry of the pull section would
41 influence the spacing and location of the puller or tensioner sites. Puller sites would just
42 be large enough to site the pulling machine and pilot line tensioner. The tensioner sites

1 would be larger to accommodate the tensioner, reels of conductor for the pull, crane for
2 lifting the reels, and pilot line winder.

3 While establishing the work sites, crews would install insulators, hardware, and sheaves
4 on the structures. This work would require pickup trucks or light-duty crane trucks, and
5 the insulators or sheaves would be raised to the structure by winch. After the insulators
6 had been installed, a helicopter would pull a pilot line from which the larger sock line is
7 pulled through the sheaves, and then the conductor would be pulled through. When
8 pulling the conductor, it would be necessary to have a complete line of sight over the
9 length of the pull section in case of a mechanical problem or if an obstacle is
10 encountered.

11 Sagging of the conductor would then be undertaken, which would require using a
12 bulldozer to provide tension to pull the conductor into the sag position. Following
13 sagging, each conductor would be marked and fastened to the insulator assemblies and
14 the sheaves would be removed. Other activities would include dead-ending, which pins
15 the conductor ends to dead-end structures, and splicing, joining lengths of conductor
16 with a hydraulic press, and installing spacers to bundled conductors.

17 Where a ground wire or fibre optic cable would be required, this would be installed at the
18 same time as the conductors.

19 **4.4.5.1.7 Upgrades to Peace Canyon Substation**

20 To connect the proposed new transmission lines and substation at Site C to the
21 BC Hydro integrated electrical system, the following upgrades would be required at the
22 Peace Canyon substation:

- 23 • Expand the existing 500 kV switchgear building to accommodate two new 500 kV
24 gas-insulated line terminations
- 25 • Install two new 500 kV gas-insulated line terminations (designated 5L5 and 5L6)
26 and associated gas insulated switchgear inside the switchgear building
- 27 • Construct steel structures for new transmission line terminations

28 The upgrades will be within the limits of the existing BC Hydro facilities. The site of the
29 switchgear building extension was cleared during the construction of the Peace Canyon
30 Project. The vegetation that has regrown since then would be cleared and grubbed.

31 **4.4.5.1.8 Decommissioning of the 138 kV Transmission Lines**

32 The existing 138 kV transmission lines between the Site C substation and G.M. Shrum
33 would be decommissioned after completion of the Site C substation and energization of
34 the first 500 kV line between the Site C and Peace Canyon substations.

35 Some of the line near G. M. Shrum may be retained to supply potential load customers
36 in the area; otherwise, the line termination equipment at G.M. Shrum would be removed.

37 The existing 138 kV transmission lines are constructed of treated wood poles and
38 steel-reinforced aluminum conductors. The wood poles are sufficiently old that they
39 could not be reused, so would be sent to a pole recycling facility for disposal or
40 recycling. Conductors and conductor hardware would be recycled at a local scrap metal
41 recycling facility. Glass insulators would be kept as spares, provided they are in good
42 condition, and porcelain insulators would be disposed of at a local landfill.

1 The equipment needed to remove the poles would include a crane for lifting the poles,
2 log trucks for shipping poles to the pole recycler, dump trucks for removing hardware
3 and conductor to the disposal facility, and a rubber-tired backhoe for excavating pole
4 butts where required.

5 The poles would be cut off and the pole butts left in the ground where possible. Where
6 the poles are located near an environmentally sensitive area, such as a watercourse or
7 wetland, or where the poles are located where a new tower foundation is required, the
8 butts would be removed, the soil excavated to remove contaminants, and the
9 excavations backfilled with clean material.

10 **4.4.5.1.9 Reclamation**

11 The temporary access roads, laydown, and staging areas used for construction of the
12 transmission lines would be reclaimed.

13 **4.4.5.2 Site C Substation**

14 **4.4.5.2.1 Site Preparation and Grading**

15 The substation site would be cleared and grubbed.

16 The substation site would be graded and structural fills installed as required to support
17 the equipment foundations.

18 Grading would require the use of bulldozers, excavators, and dump trucks to excavate
19 any unsuitable foundation material, which would then be replaced with structural fill
20 obtained from the dam site area.

21 **4.4.5.2.2 Ground Grid and Fencing**

22 The ground grid for the substation would consist of copper ground rods installed using a
23 small drill rig and copper conductors installed by excavating shallow 1 m deep trenches
24 in a grid pattern over the entire substation site.

25 Chain-link fencing would be installed around the perimeter of the substation for safety
26 and security.

27 **4.4.5.2.3 Concrete Placement**

28 Concrete would be required for all equipment and control building foundations, which
29 would be obtained from the Site C batch plant and placed using concrete trucks and
30 pumbers.

31 **4.4.5.2.4 Installation and Testing of Electrical Equipment**

32 Once the equipment foundations had been constructed, the electrical equipment would
33 be installed. This would include the assembly of the substation control building, the
34 assembly of the power transformers and filling them with oil, the installation of steel
35 support structures, and the installation of other high-voltage electrical equipment.

36 Equipment installation would require the use of cranes and crane trucks to lift and
37 position equipment and equipment supports.

38 The transformer installation would require the use of a large low-bed trailer to ship the
39 transformer tanks to the site, and the use of either a large crane or a hydraulic jacking

1 system to move the transformer onto its foundation. Transformer oil would be shipped to
2 site in tanker trucks. The oil would be treated at site (removal of impurities and water)
3 using a portable transformer oil treatment plant. During oil treatment, the oil would be
4 stored in double-walled steel tanks; then the oil would be pumped into the transformer
5 tanks. The transformers would be located within an oil containment system with a
6 capacity greater than that of the transformers to completely contain a potential spill.

7 Circuit breakers installed on-site would be insulated with sulphur hexafluoride (SF₆) gas,
8 and the installation contractor would be required to follow BC Hydro's SF₆ gas
9 management policies.

10 Testing and commissioning would require the use of high-voltage testing equipment to
11 confirm that the electrical equipment is installed properly and is ready for energization.

12 **4.4.6 Highway 29 Realignments**

13 All road construction would be performed in accordance with the current version of the
14 B.C. *Standard Specifications for Highway Construction*.

15 The Cache Creek segment would have to be completed prior to Stage 2 diversion, since
16 after diversion water levels would be above the bridge level during large floods. The
17 other five segments would have to be completed prior to reservoir filling. The
18 construction schedule for the six segments is shown in Figure 4.42.

19 Construction activities for Highway 29 would include works within the existing and
20 proposed highway rights-of-way, at gravel pits and borrow sites located within the
21 inundated areas, and at the proposed riprap quarries.

22 Site preparation would be completed at each segment and at laydown, borrow, quarries
23 and gravel pit locations. Clearing and grubbing would remove all commercial and
24 non-commercial vegetation.

25 Activities for construction of the six realigned segments of Highway 29 would be as
26 described in Sections 4.4.1 and 4.4.2, with typical site preparation, quarrying and
27 excavating, and road construction, respectively.

28 Grading to construct the roadbed and causeways would be completed at each segment,
29 including the connections to new and existing driveways, local roads, temporary
30 construction roads, and temporary traffic detours. Unsuitable native material or surplus
31 excavated material would be disposed of within the proposed highway right-of-way or in
32 designated areas within the inundated zone.

33 The Highway 29 running surface would be asphalt pavement. Asphalt plants would
34 be located in the gravel pits.

35 Most of the new highway segments and bridges would be located away from the
36 existing highway, enabling construction to take place with minimal effect to the
37 existing highway and traffic. Temporary detours would be necessary where portions
38 of the new highway overlap the existing highway. At these locations, traffic flow
39 would be managed, and could include sections of alternating single-lane traffic
40 controlled by flag persons or short-term closures. Standard traffic control measures,
41 such as signage, road markers, and flag persons, would be used for guiding traffic
42 during construction.

1 The asphalt pavement and sub-base would be removed from abandoned sections of
2 Highway 29 within the reservoir. Some reclaimed asphalt would be recycled for use
3 in the new construction. Abandoned sections of the highway located outside of the
4 reservoir would either be converted to local access roads or decommissioned and
5 restored to natural conditions. The existing bridges at Farrell Creek and Halfway
6 River may remain in place. Lynx Creek and Cache Creek bridges would be
7 dismantled. The existing bridge at Cache Creek may be returned to BCMOTI for
8 reuse.

9 All temporary construction roads and laydown areas would be deactivated and
10 reclaimed.

11 **4.4.7 Quarried and Excavated Construction Materials**

12 The activities common to quarrying rock and excavating of earthen construction
13 materials are described in this section.

14 **4.4.7.1 Riprap and Bedding Production**

15 The quarries identified in Section 4.3.5 would be used for the production of riprap and
16 bedding. Drilling and blasting would be used to break the rock. The blast hole pattern
17 and explosive loading would depend on the rock characteristics and the size of riprap
18 required.

19 After each blast, the rock would be sorted by equipment into stockpiles of the required
20 riprap sizes. This could include loading rock into a quarry rock separator. Bedding would
21 be selected from the finer rock or screened if required to produce the specified
22 gradation.

23 The yield of a quarry (ratio of volume of usable materials to total excavated volume of
24 material) depends on factors such as the joint spacing in the rock and the drilling and
25 blasting techniques employed. The surplus materials listed by quarry in Table 4.8 and
26 Table 4.9 would be unsuitable for use in the Project only because they do not meet the
27 specified gradations for riprap and bedding. Such materials could be suitable for use by
28 others in the future, e.g., crushed for rail ballast, road base, or asphalt aggregate.

29 **4.4.7.2 Excavating**

30 Blasted rock and earth construction materials would require excavation and may require
31 further processing prior to being transported to the site.

32 Excavation would typically be performed by excavator, loader, bulldozer, or scraper.

33 **4.4.7.3 Moisture Conditioning**

34 The moisture content of impervious material may require adjustment in order to meet
35 compaction requirements.

36 Water would be added to increase the moisture content using such methods as a tank
37 and spray bar mounted on a vehicle or irrigation sprays. The material would be wetted
38 and then mixed by a bulldozer or grader until a consistent moisture content is obtained.
39 Moisture could also be added by spraying the material while on the conveyor and then
40 mixed during stockpiling.

1 To reduce moisture content, the material would be disced to expose more surface area
 2 to promote drying of the material. Several turnings of the material could be necessary to
 3 achieve the correct moisture content. Another method would be to stockpile the material
 4 and allow the water to drain to the bottom.

5 **4.4.7.4 Crushing and Screening**

6 Crushing of granular materials involves mechanical breakage of particles into smaller
 7 sizes. A primary crusher and secondary crusher would be used in combination with
 8 screening. After crushing, the material would be passed through one or more screens of
 9 specified size. Screened materials would then be stockpiled.

10 **4.4.7.5 Washing**

11 Material may require washing to remove fine-grained particles in order to meet the
 12 specified gradation.

13 **4.4.7.6 Stockpiling**

14 Processed material would be stockpiled until required, or for blending with other
 15 materials, drying, or confirming of specification prior to using.

16 **4.4.7.7 Surplus or Unsuitable Materials**

17 Surplus or unsuitable materials at off-site sources would be disposed of at the source, as
 18 described in the applicable construction materials development plans (see
 19 Section 4.3.5). Unsuitable materials excavated from within the dam site area would be
 20 relocated as described in Section 4.4.3.

21 **4.4.7.8 Reclamation**

22 A reclamation plan would be developed for each quarry and excavated materials source.

23 **Table 4.11 Activities to Occur at Quarries and Materials Sources**

	Drill and Blast	Excavate	Sort	Condition Moisture	Crush	Screen	Wash	Stockpile
85 th Avenue Industrial Lands								
Wuthrich Quarry								
West Pine Quarry								
Portage Mountain/ Bullhead Mountain								
Other Sources								

1 **4.4.8 Access Roads and Rail**

2 **4.4.8.1 Construction Phase Activities**

3 All access road construction works would be undertaken in accordance with the current
4 version of the B.C. *Standard Specifications for Highway Construction*, the *Forest*
5 *Practice Code – Forest Road Engineering Guidebook*, and any applicable standards for
6 operational equipment, and in conformance with pipeline regulatory requirements.
7 Construction of rail works would be in conformance with CN Rail standards and
8 guidelines.

9 Construction of access roads would be in accordance with typical site preparation,
10 quarrying, and excavating, and with road construction activities described in
11 Sections 4.4.1 and 4.4.2.

12 Construction of access roads would require small quantities of riprap and bedding for
13 drainage works such as erosion protection at culverts and ditches as well as granular
14 material. Some fill material would come from the excavations for the road grade and the
15 remainder would be sourced off-site.

16 The granular materials for the north bank access roads to the dam site area would come
17 from the dam site area or commercial pits. Riprap and bedding would come from the
18 quarries at Wuthrich or Portage Mountain. Where riprap and bedding from Wuthrich are
19 used early in the Project, it may be replaced with the more durable rock from Portage
20 Mountain later in the Project.

21 The granular material for the Project access road on the south bank would come from
22 the Del Rio Pit and the dam site area. Materials for upgrading the existing roads on the
23 south bank would come from the Del Rio Pit or commercial pits. Riprap and bedding
24 would come from the West Pine Quarry.

25 Road grading would be required for each access road. Unsuitable native material or
26 surplus excavated material would be disposed of within the proposed right-of-way or in
27 designated areas within the inundated zone. The grading, drainage, and finishing
28 requirements would vary depending on access requirement and whether the facility
29 would be temporary or permanent. Road use and maintenance agreements would be
30 established with the forestry and oil and gas resource road licence holders. Crossing
31 agreements may need to be established with pipeline owners and operators. Upgrades
32 may include pipeline bridging, isolation, or protection.

33 Standard traffic control measures would be used for guiding traffic during upgrades to
34 existing roads.

35 Access road construction depends on the component activity schedule. Based on
36 current forecasting, the current access road construction schedule is presented in **Error!**
37 **Reference source not found..**

38 As described in Section 4.3.7, the Project access road would remain in service after
39 construction. All temporary construction service roads would be decommissioned, or
40 reclaimed and restored to their pre-existing service level following construction, or would
41 be inundated by the reservoir when filled. The abandoned section of Old Fort Road
42 would be decommissioned and returned to natural conditions.

1 **4.4.8.2 Transportation of Extraordinary Loads**

2 Dam components would need to be transported from the port of entry to Site C dam
3 utilizing highways within Alberta and British Columbia. Some of these components would
4 require routing consideration based on weight and dimensions and possible highway
5 infrastructure limitations.

6 BC Hydro engaged a the service of a specialized industrial mover to evaluate possible
7 rail and road transportation routes for the extraordinary loads. The evaluation concluded
8 that for the larger dimension components the ports of Duluth, Minnesota and Houston,
9 Texas would be suitable facilities for accepting these loads. Transportation would be via
10 highway through the United States, into Canada at Coutts Alberta, then into British
11 Columbia.

12 The proposed routing, along with the potential load parameters were provided to staff
13 with the British Columbia Ministry of Transportation & Infrastructure Commercial Vehicle
14 Safety and Enforcement Branch Provincial Permit Centre in Dawson Creek, B.C. The
15 type of loading required for the Project is not unusual and there are numerous
16 companies which specialize in transporting extraordinary dimension loads who are
17 familiar with the permitting process required by state and provincial jurisdictions
18 generally, and British Columbia specifically.

19 Based upon information from the British Columbia Ministry of Transportation &
20 Infrastructure, Provincial Permit Centre, Commercial Vehicle and Safety Enforcement
21 Branch, transportation of the components required by the Project would not require
22 upgrades or new construction of roadways or structures along the proposed haul routes.
23 However, the following would have to be taken into account by the industrial movers:

- 24 • On some bridges there may be clearance issues with railing heights and possible
25 width restrictions that would not require structural improvements but would require
26 possible temporary removal of railing to increase height clearance and width
- 27 • Any transport configurations must meet the 85 tonne route bridge restrictions and
28 would be required to go through the extraordinary load application process
- 29 • Seasonal load restrictions would affect timing of transporting over weight loads
- 30 • There would be a requirement to cross bridge structures with traffic closed and travel
31 down the centre lane for loads that are too wide to cross with oncoming traffic. Travel
32 time restrictions such as Monday to Friday, travel time of day restrictions, pilot car
33 requirements and a traffic management plan would be Part of the approval process.

34 **4.5 Operations**

35 **4.5.1 Dam, Generating Station, and Spillways**

36 The Project would be operated, managed, and maintained in accordance with:

- 37 • The terms and conditions of all permits, licences, and approvals issued for the
38 Project
- 39 • Canadian and international dam safety practices
- 40 • The Operations Environmental Management Program, described in Volume 5
41 Section 35 Summary of Environmental Management Plans

1 **4.5.1.1 Dam Safety**

2 British Columbia is one of four provinces in Canada with a formal dam safety program.
3 There are approximately 1,900 dams in the province, including some of the largest
4 structures in Canada. These dams are regulated under the British Columbia Dam Safety
5 Regulation, with oversight by the Dam Safety Program, B.C. Ministry of Forests, Lands
6 and Natural Resource Operations. The Dam Safety Section, under the Comptroller of
7 Water Rights, is responsible for administration of the provincial dam safety program and
8 regulation of major dams (9 m or higher) throughout the province. BC Hydro's Dam
9 Safety Program complies with the British Columbia Dam Safety Regulation. Dam safety
10 management of the Project would be undertaken as Part of BC Hydro's Dam Safety
11 Program and would comply with the British Columbia Dam Safety Regulation.

12 Dam operation, maintenance, and surveillance encompass a number of activities and
13 constraints so that the reservoir-retaining structures are managed safely. An Operation,
14 Maintenance, and Surveillance Manual documents:

- 15 • Procedures and practices required to operate the dam safely under various
16 conditions
- 17 • Prioritization of the maintenance activities that should be carried out for dam safety
- 18 • Surveillance, including visual inspections and instrument monitoring, as a means of
19 checking whether the dam is performing satisfactorily and as intended by the design

20 Operation, Maintenance, and Surveillance Manuals would be prepared for the
21 cofferdams and the permanent reservoir retaining structures and associated equipment.
22 Operation, Maintenance, and Surveillance Manuals would follow the CDA Dam Safety
23 Guidelines (CDA 2007) and comply with the B.C. Dam Safety Regulations. The
24 Operation, Maintenance, and Surveillance Manuals would be submitted to the
25 B.C. Comptroller of Water Rights with the Operation, Maintenance, and Surveillance
26 Manual for the cofferdams submitted prior to diversion of the river through the diversion
27 tunnels and the Operation, Maintenance, and Surveillance Manual for the dam submitted
28 prior to reservoir filling. In both cases the Operation, Maintenance, and Surveillance
29 Manuals would be submitted in sufficient time to make any changes that the Comptroller
30 of Water Rights may require prior to impounding water.

31 The goal of surveillance is to identify deviations in performance so that corrective action
32 or risk mitigation measures can be implemented before adverse consequences result.
33 Instrumentation would be installed to measure the performance relative to the expected
34 performance based on the design analyses. Instrumentation would include devices that
35 measure water pressures in the foundation or body of the dam and buttress
36 (piezometers) and devices that measure deformations. During and after reservoir filling,
37 the readings from the instrumentation would be checked against expected values. If the
38 readings indicated unsatisfactory performance, remedial work would be undertaken. For
39 example, as described in Section 4.3.1, a drainage system would be installed as Part of
40 the seepage control measures to limit seepage pressures acting on the buttress. The
41 effectiveness of this drainage system would be monitored by piezometers. If measured
42 seepage pressures are higher than expected from the design, additional drain holes
43 would be drilled until the pressures were within expected values. As described in
44 Volume 5 Section 37 Requirements for the Federal Environmental Assessment, the
45 buttresses would be designed to be stable even if the seepage control measures are

1 completely ineffective. Therefore, there would be sufficient time to undertake any
2 remedial measures required.

3 In accordance with the CDA Guidelines, Emergency Preparedness Plans describe the
4 notifications to be issued and, in general terms, the actions expected from downstream
5 responders in the event of a dam failure or passage of a major flood. Emergency
6 Preparedness Plans are not response documents but contain essential information such
7 as inundation maps and flood arrival details, so that local authorities can develop their
8 own response plans. In the event of an emergency at the dam, the local authorities and
9 other downstream stakeholders would be contacted. The CDA recommends that
10 distribution of Emergency Preparedness Plans should generally be limited to those who
11 have a legal and defined emergency response role. BC Hydro limits the distribution of
12 Emergency Preparedness Plans for security reasons.

13 Emergency Preparedness Plans would be prepared for the cofferdams and the
14 permanent reservoir-retaining structures. Emergency Preparedness Plans would follow
15 the CDA Dam Safety Guidelines and comply with the B.C. Dam Safety Regulations. The
16 Emergency Preparedness Plans would be submitted to the B.C. Comptroller of Water
17 Rights, with the Emergency Preparedness Plans for the cofferdams submitted prior to
18 diversion of the river through the diversion tunnels and the Emergency Preparedness
19 Plans for the dam submitted prior to reservoir filling. In both cases, the Emergency
20 Preparedness Plans would be submitted in sufficient time to make any changes that the
21 Comptroller of Water Rights may require prior to impounding water.

22 **4.5.1.2 Generation Operations**

23 Similar to BC Hydro's other generating facilities on the Peace River, the Project would
24 be operated to respond to provincial electricity demand. The generation and flow of
25 electricity would be controlled by BC Hydro's System Control Centre.

26 Reservoir water levels and downstream flows during operation of the Project are
27 characterized in Volume 2 Section 11.4 Surface Water Regime.

28 **4.5.1.3 Spillway Operation**

29 The gated spillway would discharge water (spill) whenever the inflow to the reservoir
30 exceeded the available capacity of the generating units. The gates would be operated to
31 maintain the maximum normal reservoir level, which would only be exceeded when all of
32 the operating spillway gates are open. Spill from the Project is described in Volume 2
33 Section 11.4 Surface Water Regime.

34 As described in Section 4.3.1.5, the spillway would have a capacity of 10,100 m³/s at the
35 maximum normal reservoir level. Extrapolation of flood frequency relationships beyond
36 1,000 years is generally discouraged (CDA 2007); however, extrapolation suggests that
37 the annual probability of exceeding the maximum normal reservoir level with all spillway
38 gates open is less than 1 in 10,000.

39 The spillway gates and undersluices would be capable of drawing the reservoir down to
40 elevation 444 m, at which level the undersluices could pass upstream flows of
41 1,600 m³/s. The facility discharge to accomplish this drawdown would likely be limited to
42 5,000 m³/s to limit downstream flooding and scour. With a mean daily inflow of
43 1,250 m³/s (equal to the mean annual flow at the site) and a maximum discharge of
44 5,000 m³/s, it would take approximately 9 days to lower the reservoir from the maximum

1 normal reservoir level to elevation 444 m. A drawdown to elevation 444 m for inspection,
2 maintenance, and repairs in the approach channel would likely be scheduled for the
3 summer between the flood hazard season and high winter flows for generation. The
4 approach channel lining would be designed and constructed to have a life of over 100
5 years; therefore, a drawdown for repairs is unlikely.

6 **4.5.1.4 Maintenance**

7 Maintenance policies and procedures would be implemented to ensure that structures
8 and equipment are maintained in a safe operating condition. Regular maintenance work,
9 including periodic servicing, such as greasing and overhauling equipment, clearing
10 drains, and removing debris, would be done in conjunction with scheduled inspections.

11 Non-regular maintenance work such as painting, repairs, or equipment replacement
12 would be undertaken as deemed necessary by either inspection or by equipment aging.

13 Debris accumulated on the trashracks on the power intakes and at the spillway
14 headworks would be removed. Wood debris would be disposed of through a
15 combination of burning, composting, or landfilling, in accordance with provincial
16 regulations in place at the time of disposal. Other debris would be disposed of in landfill,
17 in accordance with provincial regulations in place at the time of disposal.

18 Regular inspection and maintenance would be undertaken on spillway equipment,
19 including spillway gates, electrical hoist equipment, gantry travel equipment, controls
20 and limit switches. Regular maintenance would include draining and refilling hoist
21 gearboxes, lubricating moving parts, and replenishing the grease supply for the hoist
22 screw lubricators.

23 Maintenance of structural steel elements, such as the gates, gate guides, hoists, hoist
24 structures, and conduits, would also be undertaken on a regular basis.

25 Periodic maintenance would be expected to include the following tasks:

- 26 • Preventative maintenance inspections and tasks such as:
 - 27 ○ Annual servicing of cranes, gantry hoists, compressors, pumps, fans, and cooling
 - 28 water intakes
 - 29 ○ Semi-annual servicing of filters and intake gate hoists
 - 30 ○ Quarterly elevator inspection and servicing
 - 31 ○ As-required brush and slip ring maintenance
- 32 • Annual unit(s) inspection requiring units(s) outage, during which the following is
33 typically performed:
 - 34 ○ Generator winding dielectric and corona testing
 - 35 ○ Transformer oil testing and winding insulation testing
 - 36 ○ Medium voltage bus, and auxiliary systems contacts and connections cleaning,
37 adjustment, and setting
 - 38 ○ Mechanical systems – speed switch, governors, shaft packing, vacuum valve –
39 inspection and general maintenance
 - 40 ○ Turbine runner and fixed-Part inspection

- 1 ○ Trash rack inspection and cleaning
- 2 ○ Bearing oil system inspection

3 **4.5.2 Reservoir**

4 **4.5.2.1 Reservoir Operation**

5 The reservoir would have one of the narrowest normal operating ranges of reservoirs in
6 BC Hydro's system, with relatively little fluctuation in water levels throughout most of the
7 year (see Volume 2 Section 11.4 Surface Water Regime for reservoir level fluctuations).
8 Key reservoir levels are shown in Table 4.2.

9 In exceptional circumstances such as extreme floods, the proposed reservoir could rise
10 above the maximum normal level for short periods. As described in Section 4.5.1, this
11 would be a very rare occurrence.

12 The reservoir could be drawn down below the minimum normal reservoir level for
13 unusual system requirements or system emergencies. The current expectation is the
14 lowest reservoir level at which the generating station could operate during a system
15 emergency would be elevation 455 m.

16 The spillway undersluices have been designed so that the reservoir could be lowered to
17 an elevation of 440 m for inspection and repairs of the dam, generating station, or
18 spillways, but this would be a rare occurrence.

19 **4.5.2.2 Debris Management**

20 Maintenance of the debris boom logs, cable, and anchoring points in the reservoir would
21 be undertaken as necessary, based on inspections.

22 Reservoir debris management is described in Volume 1 Appendix A Vegetation,
23 Clearing, and Debris Management Plan.

24 **4.5.2.3 Maintenance of Hudson's Hope Shoreline Protection**

25 Maintenance of the shoreline protection features would require access for vegetation
26 and earthwork maintenance. The berm may require minor repairs caused by severe
27 weather events, or features may require repair. The slopes above the berm may require
28 removal of mud and vegetation that has accumulated on the berm from the slopes
29 above. The riprap may require repair periodically.

30 **4.5.3 Substation and Transmission Line to Peace Canyon**

31 Operation of the transmission system would involve transmitting electricity through the
32 conductors between the Site C and the Peace Canyon substations. The flow of
33 electricity on the transmission lines would be controlled by BC Hydro's System Control
34 Centre.

35 Vegetation maintenance would be carried out to ensure public and worker safety and
36 system reliability. Tall-growing vegetation that is capable of encroaching on the
37 transmission line and hazard trees adjacent to the right-of-way that are capable of falling
38 onto the lines would be removed or pruned as necessary to meet BC Hydro clearance
39 standards.

1 Maintenance activities would include manual, mechanical, and chemical methods for
2 maintaining vegetation at a low height to protect electrical facilities; each of these
3 general methodologies has many options.

4 Overview inspections of overhead structures would be performed regularly and detailed
5 inspections would occur approximately every five years. Overhead structure
6 maintenance could be undertaken from the ground, or by helicopter in sensitive areas or
7 where ground access is difficult or impossible.

8 Refer to Section 4.5.6 for operation and maintenance of transmission line access roads.

9 **4.5.4 Highway 29**

10 Upon completion of the new segment of Highway 29, the new facility would be
11 operated and maintained as a provincial public highway by the BCMOTI.

12 **4.5.5 Quarries and Excavated Construction Materials Sources**

13 When aggregates are required for maintenance of the dam and associated private
14 access roads, permits would be obtained as required by the regulations in place at the
15 time or commercial pits would be used to source materials.

16 **4.5.6 Access Roads**

17 Provincial public roads would be operated and maintained by BCMOTI.

18 Permanent dam and generating station and transmission line corridor access roads
19 would be operated and maintained by BC Hydro. These activities would include
20 overview inspections, occasional culvert and bridge replacements, brushing, and
21 repairing eroded areas on the road surface. The frequency of overview inspections
22 would be determined based on road risk ratings and could range from six months to five
23 years. The condition assessments made on these inspections would be used to prioritize
24 the maintenance program in relation to safety and environmental considerations,
25 business needs, and maintenance constraints.

26 **4.5.7 Sustaining Capital Expenditure**

27 The typical lifespan of major electrical and mechanical components in a hydroelectric
28 facility ranges from 30 to 40 years for the generating equipment, and from 80 to 90 years
29 for major mechanical components such as the spillway gates. The Project would be
30 designed so that all electrical and mechanical components could be refurbished or
31 replaced cost-effectively as they approach the end of their service life.

32 In addition, inspection, testing, and maintenance programs would be established to
33 maximize the expected lifespan of these components between major refurbishment or
34 equipment replacement cycles.

35 The components of the ancillary mechanical and electrical systems, such as water
36 supply and lighting, typically have shorter lives. These systems would be maintained and
37 components would be replaced as necessary during the course of normal maintenance
38 of the Project.

1 The civil structures comprising the dam, generating station, and spillway would be
2 designed to last indefinitely, with regular inspection, maintenance, and periodic repairs
3 or replacements such as:

- 4 • Replacement of weathered or damaged riprap on the upstream face of the earthfill
5 dam, and in the tailrace or discharge channel
- 6 • Repair of freeze and thaw damage to concrete
- 7 • Replacement of roof membranes
- 8 • Repair of approach channel lining

9 The frequency of such repairs and replacement would be expected to range from
10 25 years for roof membranes to 50 years, or more for freeze and thaw damage.

11 Recent examples of BC Hydro investing in its facilities on the Peace River to prolong
12 their operational capacity include:

- 13 • The generator stator replacement and turbine overhaul project at the Peace Canyon
14 generating station, which came into operation in 1980
- 15 • The spillway chute and flip bucket refurbishment at the W.A.C. Bennett Dam, which
16 came into operation in 1968
- 17 • Units 1 to 5 turbine replacements at the G.M. Shrum generating station at the
18 Bennett Dam

19 **4.6 Project Decommissioning**

20 BC Hydro expects that the Project would be operated for over 100 years, and that
21 decommissioning of permanent structures is not currently contemplated.

22 In addition to the dam, generating station, and spillway, the following permanent facilities
23 would be retained and maintained:

- 24 • Substation
- 25 • Transmission lines
- 26 • Project access road
- 27 • Realigned Highway 29
- 28 • Hudson's Hope shoreline protection
- 29 • North bank access roads

30 Should a proposal be made to decommission the Site C dam and generating facilities in
31 the future, BC Hydro would address a plan for decommissioning and restoration in
32 accordance with the applicable regulations at that time.

33 An Environmental Protection and Monitoring Plan would be developed for
34 decommissioning to implement applicable measures for environmental protection, and to
35 restore the area to conditions deemed acceptable at the time of decommissioning.
36 Further details on decommissioning would depend on regulations and practice at the
37 time of a decision to decommission.

38

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2 **Literature Cited**

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